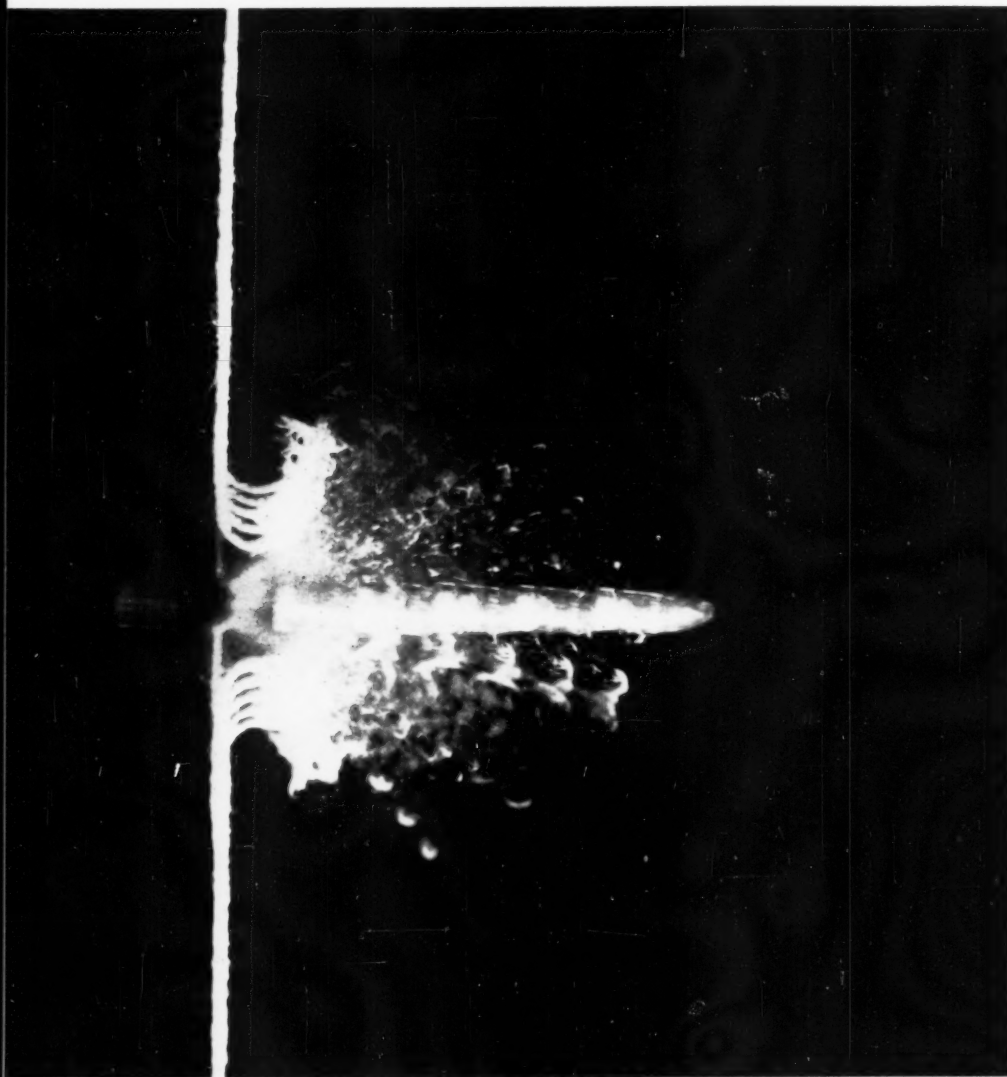


Compressed Air

Magazine



NOVEMBER 1959

IN THIS ISSUE

CHRYSLER'S IMPERIAL
GAS CATACOMBS
BIG BUBBLES UNDER DOVER
THE VASA SAILS AGAIN
PACKAGED NITROGEN
INDEX AND COVER STORY, PAGE 1

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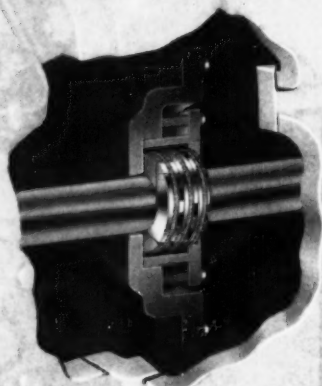
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COMPRESSED AIR MAGAZINE, NOVEMBER 1959

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For Prompt Service, contact one of our 26 sales offices and warehouses throughout the U. S. and Canada.

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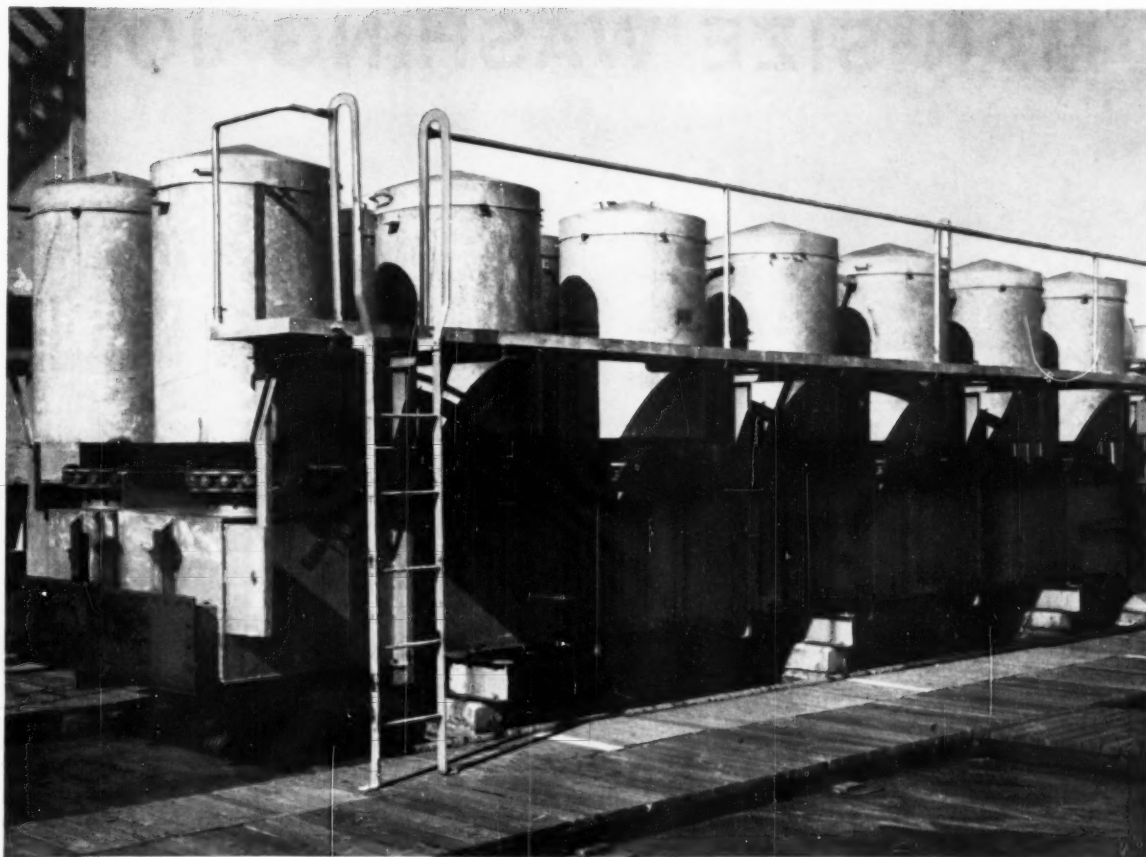
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Staynew air-intake filters control intake-processing air at E. R. Squibb Division of Olin Mathieson Chemical Corporation.

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MAN-SIZE WASHING JOB



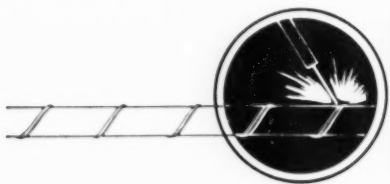
Naylor Spiralweld pipe was selected for this unusual project where a large volume of water was required for grading gravel.

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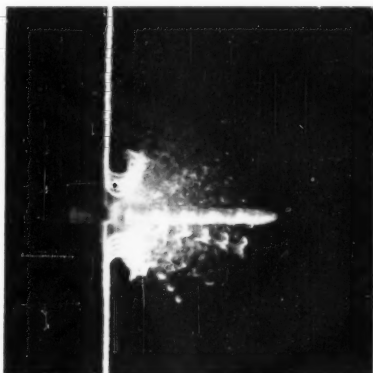
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ON THE COVER

STOPPING motion is a favorite—and useful—trick of photographers. In industry today, the technique can often be used to great advantage by designers. The cover picture shows what happens when a bullet pierces a string, and illustrates the advances made in ultra high-speed multiframe techniques. Dr. Harold Edgerton used six separate exposures on one film to get this picture. Each flash was for 1/1,000,000 second with a delay of about 1/100,000 second between each exposure. The white line visible on the projectile in the successive exposures shows its rotation.

VOLUME 64 NUMBER 11

November 1959

FEATURE ARTICLES

Page 10 Imperial—S. M. Parkhill

Quality control is a subject vital to all industries that want to compete in the consumer market. Chrysler Corporation uses a well-developed system that relies upon skilled craftsmen and precision tools.

16 Catacombs for Gas—Robert James

Mining techniques enabling efficient work through a 42-inch diameter "keyhole" have been worked out to excavate underground storage for liquid petroleum gases. The operation is described in story and pictures.

20 Bubbles, Breakwaters and Brasher—G. R. Smith

The air-curtain breakwater has been featured repeatedly in these pages for more than 50 years. Although proved successful in almost every instance, it has never achieved popularity. Perhaps the described application will finally sell its merits.

22 The Strange Voyages of the Vasa—Peter Sleight

Stockholm harbor is the site of the onetime pride of the Swedish navy's travels. When her last trip has been made, a nautical prize will have been preserved.

26 All in a Day's Work

No task is unusual enough to be out of the question for the regulator described in this article.

29 Nitrogen From a Packaged Generator

Inert gas atmospheres have a wide variety of uses. Complete packaged systems for producing nitrogen blankets are available.

DEPARTMENTS

24 This and That

27 Editorial—Steel

28 Saving With Air Power Applications—

*Installing Rail-Car Bearings
Wet-Blast Cleaning*

31 Industrial Notes

47 Index to Advertisers



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with **MORE POWER** and **MORE PERFORMANCE**

Ingersoll-Rand, the pioneer builder of portable rotary compressors, now offers a completely new size Gyro-Flo portable—the DR-365. This rugged, all-new compressor provides 365 cfm of mobile air power—16% more than its predecessor, the Gyro-Flo 315. Yet, the DR-365 is no bigger than the 315 cfm Gyro-Flo, and its larger, more powerful engine retains the same 1800 RPM speed.

Take a closer look at what this all-new compressor offers: A new, simplified, more-efficient compressor system with...automatic drainage of oil from cylinders when the unit is shut down...dependable Air-Glide capacity control for 100% stepless regulation...a 12-volt battery system for faster, easier starting...side covers that fold back safely out of the way...a full-length, large capacity tool box to provide extra storage space...all operating controls, fuel tank, filters and tool storage enclosed by lockable side covers. These are just a few of the many features that mean more power, better performance, and greater convenience and safety, too.

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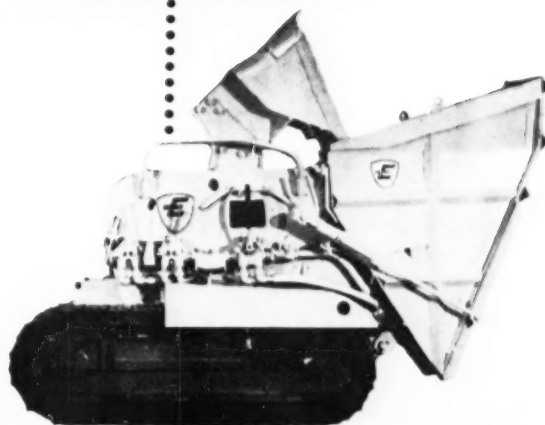
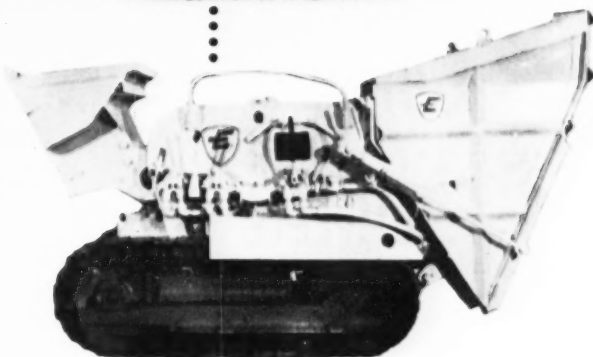
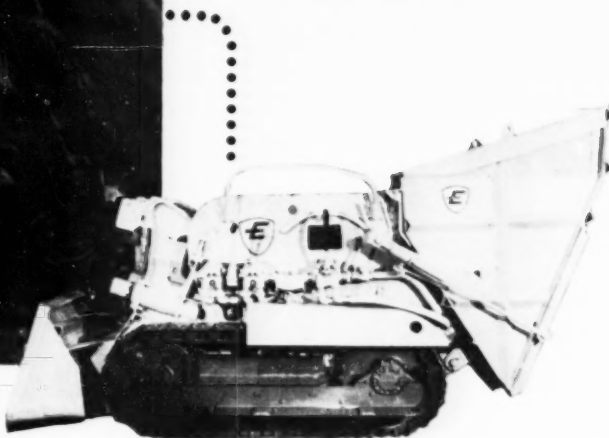
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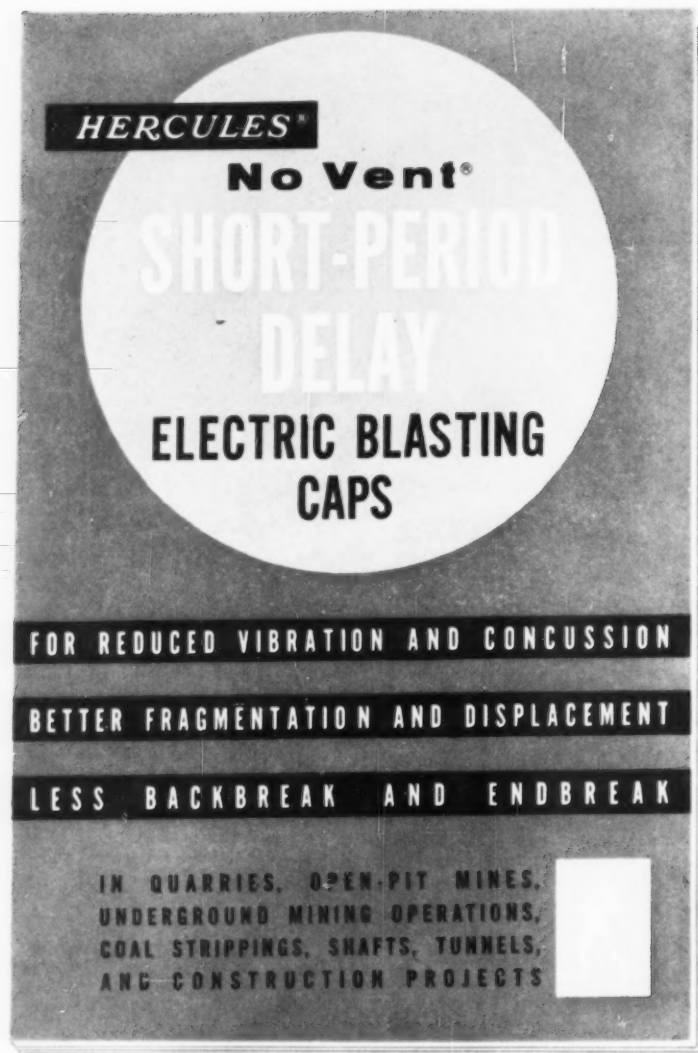
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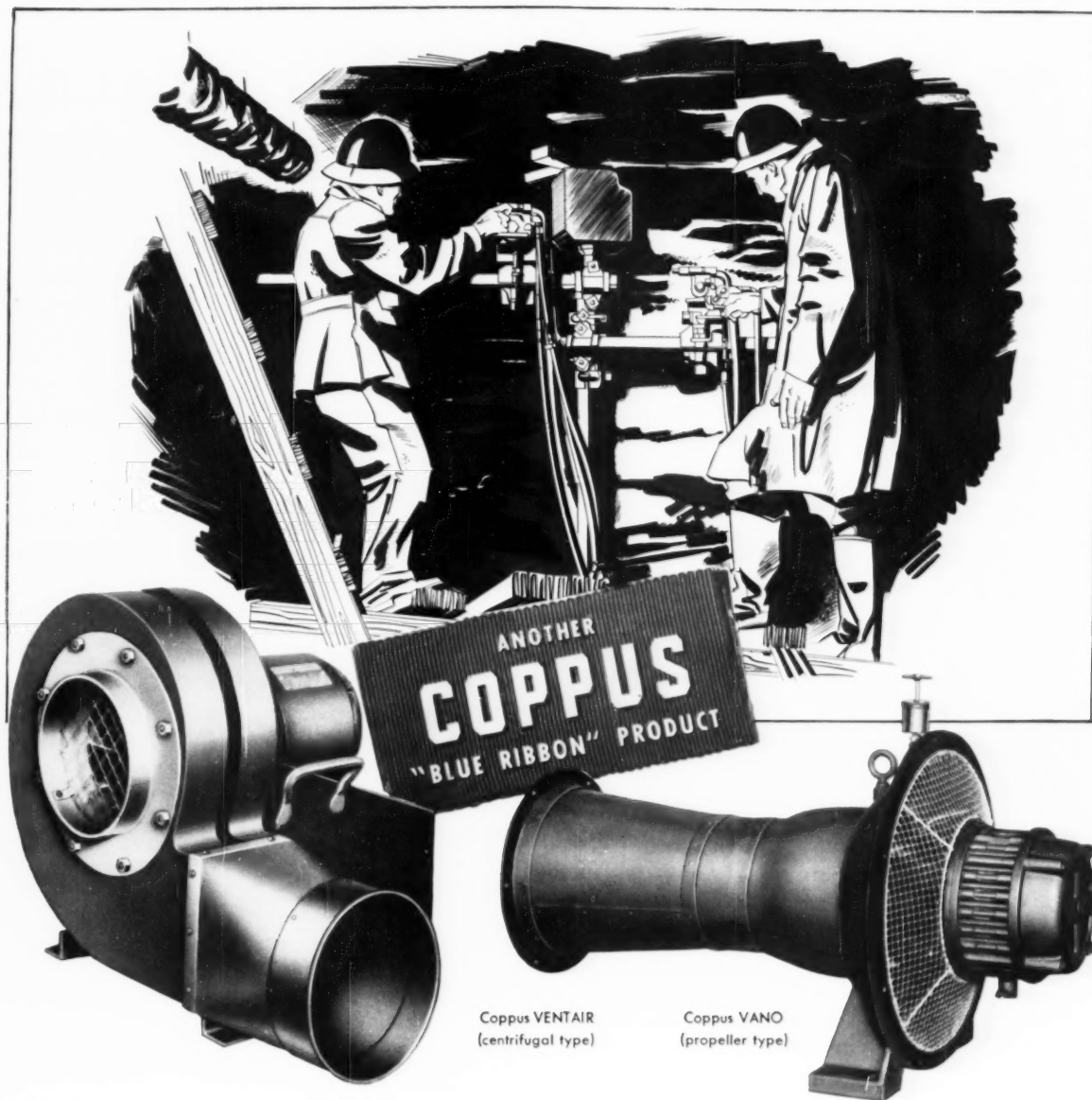
To help acquaint you with this extended series, Hercules has prepared a 20-page booklet describing the characteristics of the caps, indicated uses, and recommended procedures. If you don't already have a copy of this valuable guide, you'll want to ask your Hercules representative for one. At the same time, he'll be glad to tell you more about how Hercules Blasting Caps can best meet your specific requirements.



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Coppus VANO
(propeller type)

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18% more output ... for
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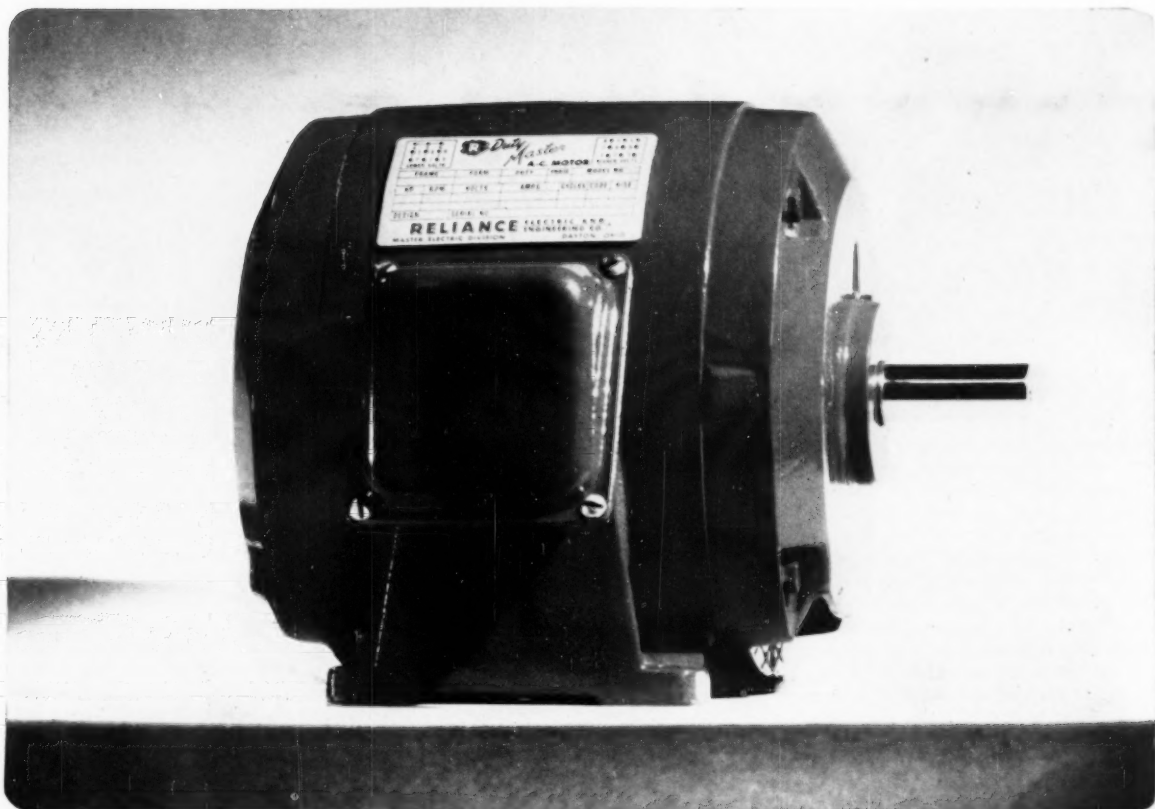


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Tools plus AIRengineering
increase output per man





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a brand new a-c. motor

Product of Reliance Electric and Engineering Company and its Master Electric Division, Duty Master's new design gives users better protection from the inside out, simplified lubrication, better response and improved all around performance. The Duty Master line, from protected open, to totally enclosed, explosion-proof, 1 to 250 hp., is ready for delivery NOW.

Duty Master's insulation, by means of a series of multiple dips and bakes in thermosetting varnish plus final protection in finishing enamel, makes it resistant to water, acid, dirt and other contaminating elements . . . adds years to motor life.

"Metermatic" lubrication regulates flow of grease to the bearing—provides automatic grease relief. No danger of over-or under-lubrication . . . no maintenance headaches.

Duty Master's low inertia rotor has faster response in starting, stopping and reversing. This, plus better ventilation and increased accelerating torques, permits frequent starts and stops without over-heating.

Duty Master's new design proves conclusively that all a-c. motors are *not* alike . . . that this new motor gives users the best value in industry today.

Call your Reliance Sales Engineer or distributor—listed in the Yellow Pages—for the complete story, or write for Bulletin No. B-2106, Reliance Electric and Engineering Company, 24701 Euclid Avenue, Cleveland 17, Ohio.

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IMPERIAL

S. M. PARKHILL

BYOND Detroit's west side, along a highway in Dearborn, Mich., an unassuming manufacturing plant stands. From the outside, it looks like any automobile facility in the area; but inside, the assembly plant is an automotive anomaly. There, workmen are turning out a product that symbolizes luxury and quality to the U. S. consumer—the Imperial. Like other companies in the industry, this division of Chrysler Corporation relies heavily on automation; unlike them, it combines a unique quality control program with handicrafts long-lost in American motorcar tradition. The use of torque controlled pneumatic tools is vital in both the role of automation and handwork. They help assure Imperial quality.

In a typical 5-day week, within the confines of this 48-acre site, about 2000 men and women work 8 hours a day along 11 miles of conveyor lines to produce more than 200 Imperial, Imperial Crown and LeBaron models. Such a production rate is slow for the American industry, but it is the fastest possible if the desired quality is to be maintained—a quality that Imperial owners have come to expect.

The first Imperial was produced in 1926. In 1955, its distinct style set it apart from other Chrysler cars, and 2 years later, body parts were no longer interchangeable with other corporate models. This made reasonable a separate assembly plant, and reports from dealers indicate that customers are reacting favorably to the segregation of this line from the other Chrysler plants.

Quality Control

To cope with market competition, close control of manufacturing quality is demanded. The lack of quality in production is one of the principal worries confronting U. S. management, falling just short of rising costs and waste. Manufacturing processes involving large-volume output and repetitive assembly operations typical in the automobile industry, are fertile grounds for quality control.

To wait until each unit has been completed to check quality often results in expensive reworking or rejections. Quality must be checked periodically all along the line—in preproduction, sub-assembly, and final assembly. Along the Imperial assembly line are 38 quality control stations. Checked are every vehicle's body metal and paint finishes, joint fits, deck lid and compartment assemblies, door fittings, carpets, trim, glass, hardware, inside molding, instrument board assembly, electrical accessories, engine function, transmission, clutch, rear axle noise, steering, fluid leaks, body and chassis squeaks and rattles, and general cleanliness, as well as a myriad of seemingly minor details. Checking devices of all types have been devised to do the task. Some are simple, as a template for verifying window and door opening dimensions. Such fixtures can be seen hanging in strategic locations along the production lines. Others are more elaborate, such as the so-called R-1 master body checking device used to spot check body dimensions.

Most spectacular of the devices is the static water test booth. This is de-

signed to check every Imperial for weather tightness. An inspector rides each car through the room looking for leaks, while 118 jet nozzles (22 of them directed at the underside) simulate a downpour of 252 inches of rain an hour. The booth is located on the final assembly line.

Imperials to be equipped with air conditioning pass to a special conveyor system so that refrigerant charging and testing operations can be done as efficiently as the basic assembly is. Special checking devices are incorporated in this line too. An electronic "sniffer" detects refrigerant leakage so proper line adjustments can be made. A hot room simulates temperature and humidity conditions to check the quality and effectiveness of air conditioner operation.

Gauging and control devices alone, no matter how elaborate, will not assure a quality product. The human element is equally important. One hundred control personnel gather quality data at the Imperial Division. This information is sent to a control section. Engineers analyze the data and chart the information to graphically illustrate over-all trends. This group feeds its interpretations to line foremen so that corrective action can be taken where necessary, whether it be in production or preproduction stages. Commendations are also passed along in this manner to the foremen as well as the individual workers, showing them that they are an important part of the Imperial reputation. The men take pride in telling visitors about their work, their plant and the quality of their product.

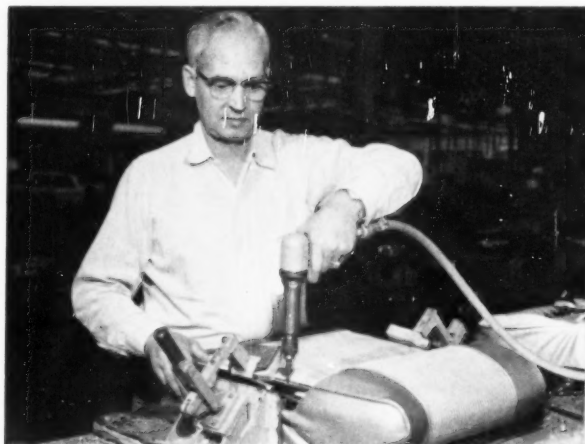
Much of the data eventually appears in a company publication, *Quality Digest*. This weekly bulletin lets Imperial workers know where the division stands in relation to the other corporate divisions. Both general reprimands and commendations are passed along in this manner too.

In the complexity of such a system, a control is mandatory. A group of expert quality control auditors is responsible here. They daily spot check hundreds of items on the Imperials. Their concern is with four basic categories: body-in-white metal, water seal test, visual body finish, and a functional check. Both the finish and functional check include a 30-minute road test. (This road test is unique in Detroit. Every Imperial is tested over bumpy, rolling and smooth roads while brakes, engine, transmission, and axles are evaluated. Over-all handling quality is also graded.) The control auditors make their inspections unannounced and are free to check any vehicle at any time. From their data sheets, daily and monthly reports are made. These are passed to management and production supervisors as a control factor in making the operation of the entire program effective. The data are then sent to corporate level management.

Handicrafts

Quality control in manufacturing alone will not produce luxury cars. Handwork and craftsmanship are important elements. Management realized that craftsmen must be trained in new methods if they are to maintain their

(Text continued on page 14)



PNEUMATIC PIERCING

At left is shown a piercing operation on the back of the front seat cushions. The operator inserts stuffing and a fiber partition for stiffening, then pulls the upholstery taut and pneumatically staples it in place. The seams are covered with a chrome strip. An Ingersoll-Rand AVA 12 Riveter, working as a piercing hammer, punches screw

holes for the seat back molding screws. Metal from the hole is extruded downward leaving a smooth outer surface and a long, self-threading section on the reverse side of the molding. This gives the fasteners a longer threading area for improved quality. The swivel-seat frame is pierced in the same fashion for drive-nail holes (right).



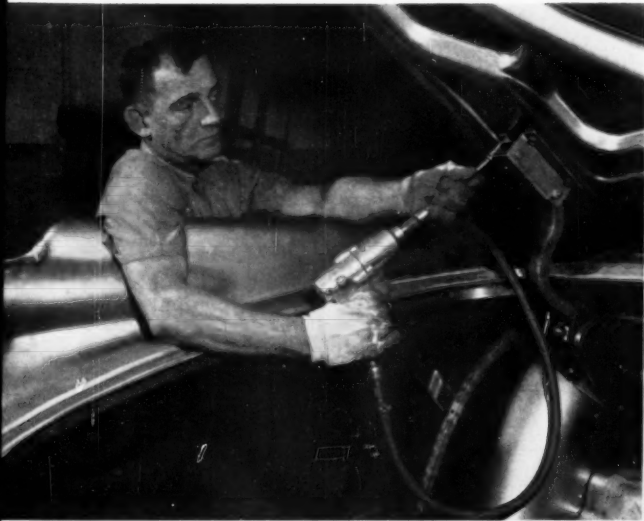
The door assembly area follows the solder weld grinding shop, which can be seen in the background of the photograph at the left. The bodies move toward the camera position and circle to the left, to the deck lid assembly line.

Body-in-White

DOOR ASSEMBLY: Seventeen sets of doors are hung every hour at this station. The operation is especially critical, for if the fasteners that attach the hinges to the doors and front pillars are not properly torqued, the door will fit poorly and will rattle. Consequently, Torsion Bar Torque Control Impacttools are used. The door is first placed in a jig (below), and two hinges are inserted into the proper position. The operator uses an Ingersoll-Rand 5040T Torque Control Impacttool to run three cap screws in each door hinge to a specified torque of 20 foot-pounds.

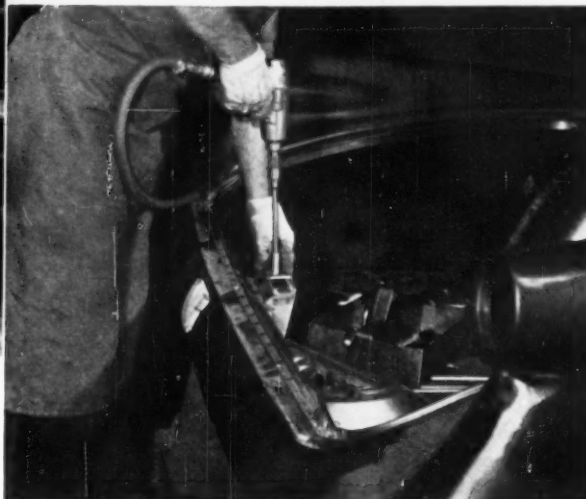


DOOR HANGING: The subassembly is next moved to the line where the worker fastens it to the front pillar with three door hinge bolts in each hinge section. The Impacttool used here is especially handy because the worker can position the door with one hand while the second is used to run the fasteners.



DECK LID ASSEMBLY: This is the last assembly operation in the body-in-white department. The operator attaches the deck lid to the hinges at the rear of the Imperials. Shown above is a bolt on a hinge being run to a torque of 115 inch-pounds with an I-R 5020T Torque Control Impacttool. Four of these fasteners attach the deck lid to each of the two hinges.

STRIKER PLATE ASSEMBLY: While the deck lid is being assembled, the striker plate is also being attached (below). Here the operator is running screws to fasten this part to the running deck. He too uses a 5020T tool and runs the screws to a torque of 200 inch-pounds. From here, the body-in-white cars are inspected, and are sent directly to the paint department to the left of this line.



TWICE OVER AND INSPECTION

Each automobile receives two complete water sandings (above). This assures a satin-smooth finish by preparing the body for succeeding coats of paint. The smooth surface holds the paint more readily. Sanding is done pneumatically because of the wet atmosphere, and the water acts as a lubricant to prevent scratching by the fine abrasives. At the right can be seen one of the quality control inspection stations where the body receives a final check for surface luster.





WAITING FOR THE CHASSIS

Trimmed body storage (left). A master control panel located along the assembly line monitors these body feeder lines to assure each is placed on its proper chassis. This static body control system eliminates congestion of work in any one area along the body-drop portion of the line and is the first of its kind in the industry.

high status in their trades. A company-sponsored training program was begun. The electric welding department is indicative of the value of such a program. The men were given a 5-hour course in automotive spot welding technique. Afterward, quality control inspectors reported a substantial over-all improvement in the more than 6000 welds that go into the making of the Royal Coach Body.

An important and unique hand operation is the soldering of all seams and joints. They are smoothed with air-powered grinders in a specially enclosed area on the assembly line, and the result is a body without apparent seams.

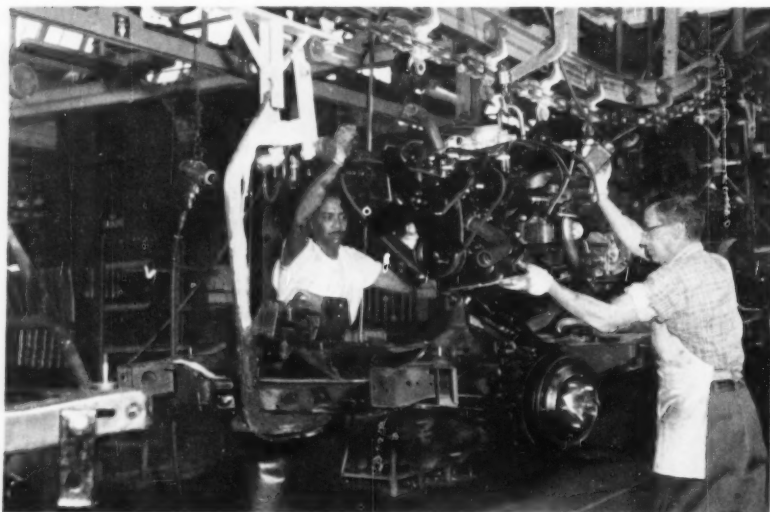
Leather for the upholstery is typical of Imperial excellence. Specially selected Grade No. 1 steer hides are inspected for blemishes. The cutting department takes the required uphol-

stery pieces from the perfect areas, and discards all parts with imperfections. Although choice hides are used, the discarded portion amounts to about 25 percent of the skins.

Of all the factors that place the Imperial high on the luxury scale, the paint finish is perhaps the best known. It results from a combination of patient handwork, special processing, and carefully controlled atmosphere. Painting is done in an area that is actually a building within a building. About 8 hours are required for each coach to pass along the 1928 feet of conveyor lines.

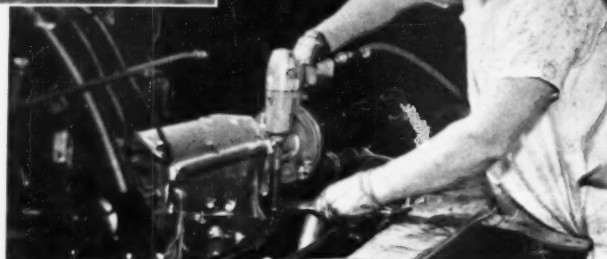
Air is sucked into an air filtering center at a rate of 1,500,000 cfm. It is forced through a mesh screen with $\frac{1}{2}$ -inch holes, then passes over fixed weather louvers. A series of spray nozzles wets the air, eliminating heavy foreign particles. It then travels through roll-type filters, and is blown into a plenum chamber and spray booths with walls, ceilings, and floor covered with a sticky substance that catches any remaining particles. Four-inch-thick filters are next used to eliminate trace dust. To prevent dirty air from entering the paint building's controlled atmosphere, the air is slightly pressurized and is constantly moved outward.

Such attention to dust-free air is essential to maintain the final luster and durability of the paint. In addition, many operations are required for each body. The shell is given an alkali wash, two water rinses, a phosphate coating, another rinse and a chromic rinse to neutralize body residue. This



ENGINE DROP

The illustration above shows the engine being placed from an overhead conveyor to the chassis. The engines, which are manufactured at Chrysler's Trenton, Mich., facility, are moved from a storage-receiving area by crane to this point. When the engine and the chassis have been assembled, they pass through the engine dress-up line where Ingersoll-Rand 504CT Torque Control Impacttools tighten the rear engine support bolts to the frame with a 35-foot-pound torque. This is shown at the right. Wheels are then attached, and the frame moves to the body-drop area.



is followed by an acid cleaning of all solder joints and a rubbing with a cloth ball. All solder areas are sprayed with clear epoxy to prevent blotching, and metal imperfections are knife glazed for perfect smoothness. Next, all interior and exterior parts are given two coats of primer as a rust, chip and blister preventative.

After baking at 350° F for 30 minutes, the body is pneumatically sanded with No. 360 (fine) sandpaper and water, as illustrated on page 13. The joints are then sealed and undercoating is sprayed on. A sealer is applied to the entire body to create the final luster base.

Another 30-minute baking period precedes a second water sanding, this time with No. 400 (very fine) sandpaper. A lukewarm water rinse, followed by a gasoline wipe, drying, and cleaning, eliminates all dust. Then two coats of super high-baked enamel are sprayed onto the body, one coat following the other without a drying period.

As the cars move from a final 30-minute baking period, an inspector checks for imperfections and indicates areas that need refinishing. Two coats of color are applied over the basic one

FRONT SUSPENSION ASSEMBLY

This worker uses an Ingersoll-Rand 38PM angle wrench to tighten caster and camber adjustment bolts. The chassis frame is gauged up first, then this torque controlled wrenches make the final tightening adjustment. The bracket that can be seen mounted on the tool rests against the car's frame and absorbs the torque reaction, for this is a powerful 100-foot-pound tool which would quickly fatigue the worker were not this provision made.

for those cars that are to receive the 2-tone treatment. On an average, 4 gallons of primer, sealer, and finish paint are applied to every Imperial.

Like other automobile facilities, the Imperial assembly plant also relies upon the repetitive accuracy of precision tools, in addition to its specialized dependence upon hand skills, to turn out its quality product. Air power is used almost exclusively for its many advantages. With the addition of Torsion Bar Torque Control, described below, the division's engineers can rest assured that the work will be done not only with ease and speed, but with consistent accuracy.



TORQUE CONTROL

TORQUE control is important in both the handwork and the quality control that are so vital in the production of an Imperial. The operation of a Torque Control Impacttool is basically simple. It differs from the normal Impacttool principally in the construction of its spindle. The most important part of its spindle consists of a bar—a Torsion Bar—that can be twisted (preset) to a specific torque. When the bar is twisted, that is, prestressed, the twisting is done in a direction opposite to the one in which the fastener is to be run. In running the fastener, at first the bar simply transmits rotary motion—it acts as a solid member. However, as the nut is tightened and its resistance increases, the tool begins to impact like any other Impacttool. Eventually the resistance of the fastener to torquing equals that preset in the Torsion Bar. When this point is reached, rebound in the tool's driving mechanism cuts off the air to the tool, stopping it as described in the pictures and caption at the right. The nut has been tightened to the preset torque of the Torsion Bar.

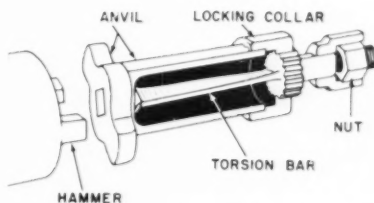
This operation can be repeated indefinitely, and every nut will be tightened to an identical torque. Should a greater or lesser torque be required, the tool can be readily reset. To do this, the Torsion Bar is twisted in a special jig,

and a locking collar on the spindle of the tool holds the bar at the new setting.

Torsion Bar Torque Control was introduced to air-operated Impacttools by Ingersoll-Rand Company late in 1955, and has proved to be of inestimable value to users of pneumatic tools. It has opened new fields of air applications, and has expanded many old ones. It has added considerably to the list of air-operated tool advantages.

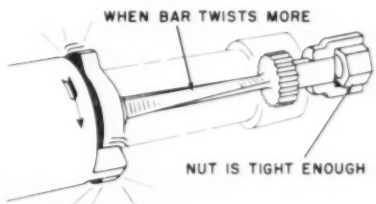
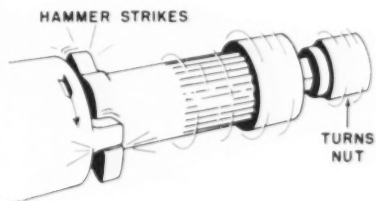
Other methods of controlling torque

have been tried in the past, but each proves inadequate for a variety of reasons. Hand wrenching in assembly line work is out of the question because it is too slow. Air tools that depend on adjustment of pressure for torque regulation can transmit excessive torque reaction to the operator. When the tool is heavy and is used either constantly or in awkward, hard-to-reach areas, work becomes tedious and employee efficiency and morale drop rapidly. Some tools utilize a slip clutch action, but this can cause considerable heating, making lubrication and adjustment critical. Also, tools equipped with a slip clutch are generally heavier.



TORSION BAR PRINCIPLE

The three line drawings indicate the operation of Torsion Bar Torque Control as described in the accompanying text. In the first, the principal components are shown. They include the anvil, the Torsion Bar and the locking collar. The Torsion Bar acts as a solid member during the turning of the nut, in the second illustration. When the resistance of the nut is greater than the preset torque of the Torsion Bar, the hammer rebounds to shut off the tool.



CATACOMBS FOR GAS

ROBERT JAMES

STORAGE of man's possessions out of harm's way and yet within easy reach has been one of his perennial headaches since the time that he had only a few furs and stone implements in his cave. In a way, with recent projects for the storage of a wide variety of products, the search for places of safe keeping has come full circle, for many firms and governments are going underground and using natural or man-made caverns for the purpose.

Texas Eastern Transmission Corporation was established in the mid-1940's to bid on the Big Inch and Little Big Inch pipelines. Wartime wards of the government, the 24- and 20-inch crude-oil carriers were offered for sale in 1946, and in the following year were purchased by Texas Eastern. The Inch lines were then shifted to the transportation of natural gas. Several years ago Texas

Eastern sought permission to remove the Little Big Inch from gas service and to convert it for duty as a carrier of fluid petroleum products. The Federal Power Commission granted the request in January 1958.

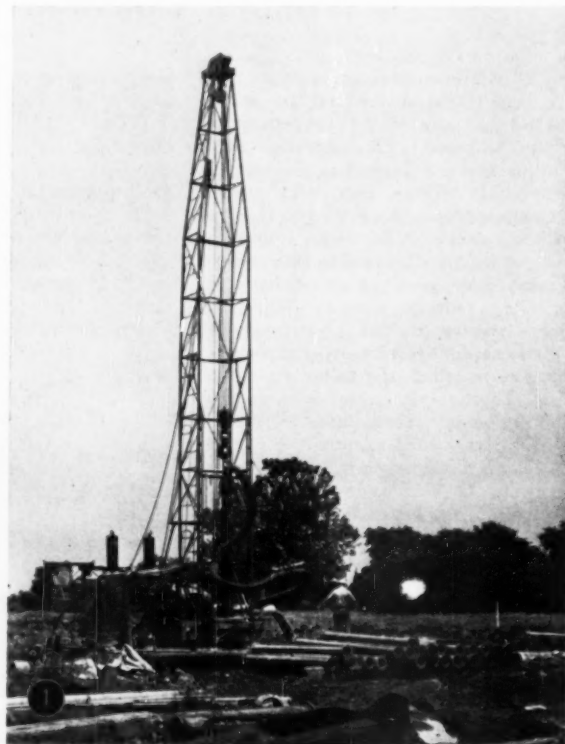
Today the Little Big Inch, with extensions, totals more than 1800 miles of service piping through which a wide variety of petroleum products is pushed by twelve pumping stations with a total 24,000-hp pumping capacity. In July 1958, with the opening of the converted line, Texas Eastern announced that for the first time shipments of liquefied petroleum gas would be accepted for transport. The LP gas was to be carried to the Company's Todhunter Terminal at Middletown, Ohio, about 30 miles north of Cincinnati.

The very nature of pipeline service calls for vast storage facilities at termi-

nals. The line is a paying proposition only when products move steadily through it, thus there must be a good-sized reservoir at the terminal to handle fluctuations in demand. Because LP gas is largely subject to seasonal demands, something out of the ordinary in capacity was required for the new Todhunter facility. When it is considered that the terminal is to supply LP gas by rail and truck to users from Michigan to Maine, some idea can be had of the magnitude of the storage volume required. Texas Eastern is now whittling away at five honeycombs, some 350 feet below the surface of the terminal and that will hold 835,000 barrels of LP gas. The caverns will be the equivalent of about 185 spherical tanks of 35-foot diameter. General contractor for the work is Fenix & Scisson, Inc., Tulsa, Okla.

MINING THROUGH A KEYHOLE

A description of the actual mining technique used by Fenix & Scisson is best given with photographs. While most of the pictures used are from the Texas Eastern caverns at Middletown, some are of other jobs. It is understandable that photos in cramped quarters are difficult to take, therefore certain parts of these other jobs lent themselves more readily to the taking of pictures.



In opening the caverns from the surface, the drill rig shown cuts a cored hole to the appropriate depth. After lining with 42-inch-diameter steel pipe, the initial heading is cut . . .

One cavern will have a capacity of 150,000 barrels (6,300,000 gallons); one will have a capacity of 200,000 barrels (8,400,000 gallons); a third, 125,000 barrels (5,250,000 gallons); the fourth, 160,000 barrels (6,720,000 gallons), and the fifth, 200,000 barrels (8,400,000 gallons). Engineers estimate that when the five caverns are completed, enough area will remain in which storage caverns can be constructed to give the terminal a total capacity of 1.8 million barrels or approximately 75,600,000 gallons of LP gas. The first cavern has been purchased by Cincinnati Gas & Electric Company; the second has been leased to Phillips Petroleum Company; three and five will be retained by Texas Eastern for its own use; and cavern four will be purchased by Dayton Power & Light Company.

The caverns are being excavated in the form of a honeycomb of interconnected tunnels, most of which are 15 feet wide and 20 feet high. Work began in September 1958, when the first shaft was opened. Three caverns are essentially completed at this time. Cavern four will be completed and put into service this month; cavern five is expected to be completed in February 1960.

The underground formation, although pervious to water to a degree, will hold liquefied gas because the vapor pressure of liquid propane is less than the hydrostatic head on the 350-foot-deep caves. Thus there will be, if anything, an inflow of water to the gas storage area, rather than any outflow of gas. The stored material will be extracted near the bottom thereby removing seepage along with the desired LPG. The gas will then be dried thoroughly prior to delivery to consumers.

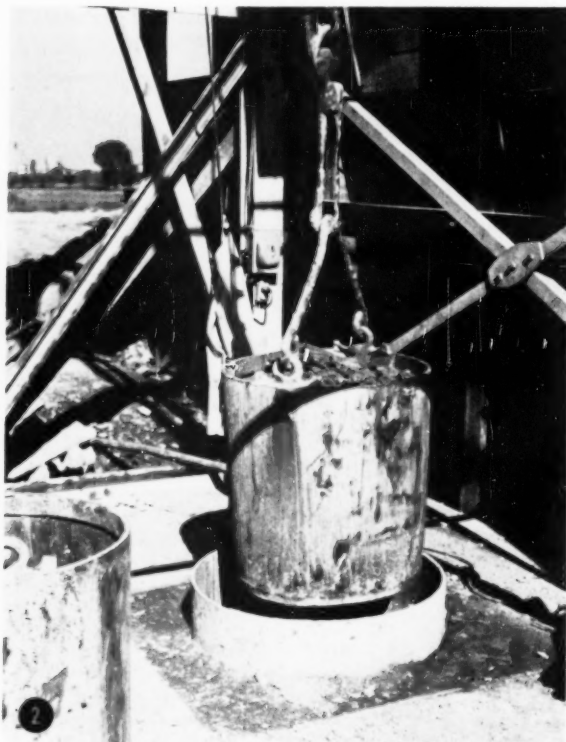
The economics of Texas Eastern's gas storage caverns are quite simple. Pressure tanks for propane, above ground, cost from \$14 to \$16 per barrel of capacity, and also take up a great deal of land that may be quite expensive itself, depending on the location of the storage plot. A mine cavern, according to National Petroleum Council figures, costs from \$2.50 to \$5.50 per barrel of capacity, or about one third as much. In addition, underground caverns, whether natural or man-made, require no maintenance or painting to protect them from corrosion, and keep the highly flammable hydrocarbons safely away from surface hazards such as fires and storms.

The storage of LP gas underground is

a relatively new technique. The National Petroleum Council estimates that about 7,000,000 barrels was stored in that fashion in 1952. By 1956, the total was 25 million barrels, most of which, however, was in depleted oil and gas wells, with a small portion in caverns washed out of salt domes. By 1957, almost 30 million barrels was underground with an increasing proportion in mined caves. It is only in the last 3 to 4 years that mined caverns have been utilized to any extent, and Fenix & Scisson, Inc., have contracted many of them.

The contractor thus has built up a valuable well of experience on which to draw, particularly in the realm of operating through the 42-inch diameter access shafts which are, perhaps, the most striking feature of these jobs.

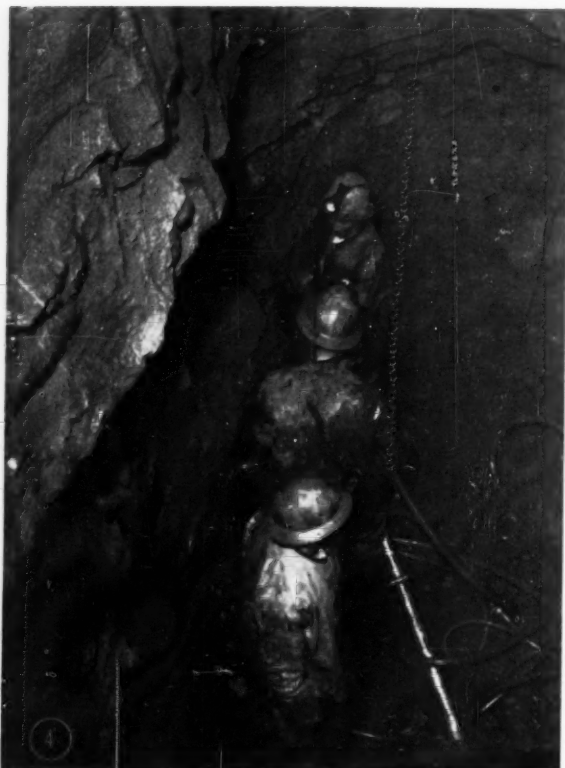
Shafts were drilled to a depth of about 380 feet and 52 inches in diameter. After a hole was bottomed, about 30 feet was backfilled with sand to aid in positioning a 42-inch inside-diameter steel casing. Having $\frac{3}{4}$ -inch walls, this casing was placed in 20-foot sections. The bottom section was plugged with concrete so that it would float on ballast water pumped into the shaft. Additional sections were welded on as the



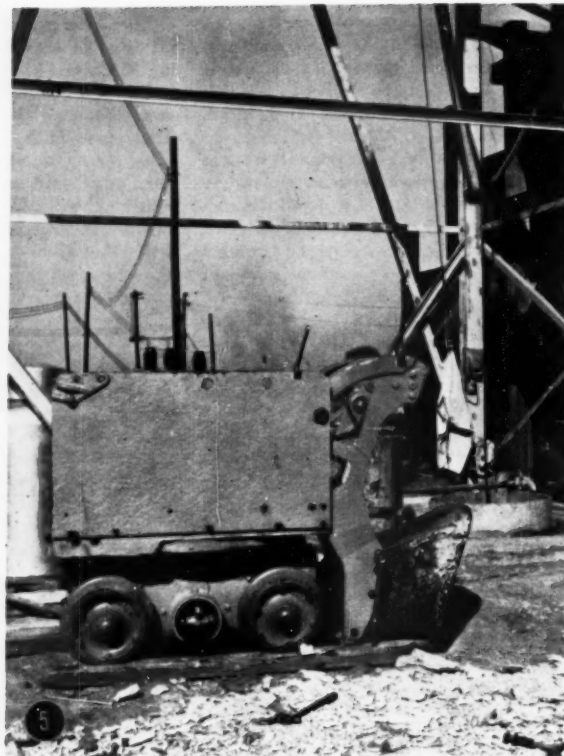
by a miner working from a mine can, such as this one, and using an Ingersoll-Rand hand-held Jackhammer to drill a few holes at a time. After blasting...



a foothold of about the size and form of the one illustrated is obtained. Then, with sufficient working room, Jacklegs are added to the drill, making up the familiar JR-38B Jackdrill combination. This is used in...



pushing the opening outward and deepening it to the ultimate floor line of the cavern. After this is done . . .



enough room is available so that mechanical mucking equipment can replace the hand shovels previously used. First to go underground is this Eimco overshot mucker . . .

tube made its way down, controlled in its descent by water pumped into the casing and out of the shaft. As the liner descended, service pipelines were tack welded to its exterior as were metal leaves from truck springs to aid in centering it in the hole. Grout pipes also made the trip down the shaft with the casing. After the tube bottomed on the sand plug, it was concreted in place as the grout pipes were withdrawn.

Chief among the reasons for limiting the shaft size is the fact that the caverns and shafts, when in use, will be under pressure to keep the gases in liquid state. It goes without saying that a 42-inch drilled shaft is considerably easier to seal than would be a larger excavated one whose walls might have been shattered by the use of explosives. Engineers have described the project as a large flask-shaped pressure vessel. The shaft is the neck and, when work is completed, will be "corked" by a steel dome at the top. Propane will be injected and withdrawn in liquid form through pipes descending the shaft through this dome.

The trickiest operation of the job is to turn headings from within the 42-inch diameter hole, and the first one for each cavern is the most difficult.

After the initial heading is opened, a drift can be pushed to intercept other access shafts, thus gaining sufficient working space at the foot of each for crews to operate efficiently.

Turning the first headings follows a definite pattern. First the concrete plug in the shaft is removed and the sand backfill and water in the lower portion are bailed out. Then a driller, using a Jackhammer and operating from a spoil bucket hung in the shaft, sinks diagonal holes just below the edge of the casing and all the way around it. These are loaded and blasted, the muck dropping into the bottom of the shaft where it is left until later stages.

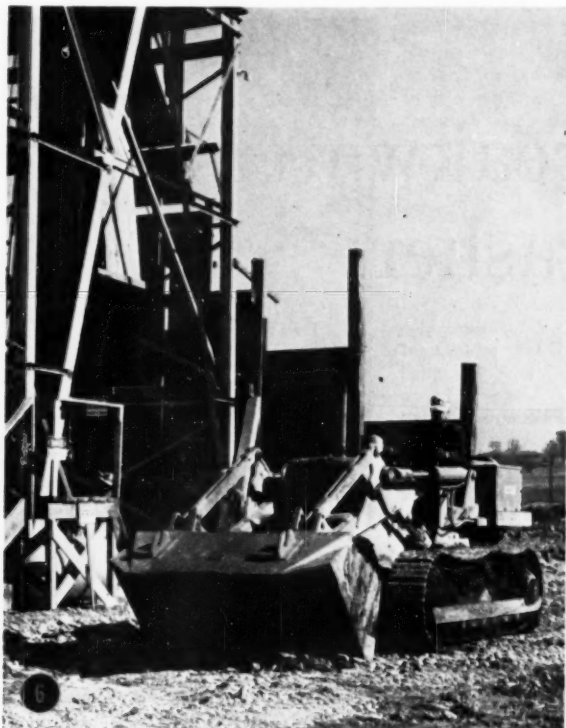
This provides room for additional work, and Jacklegs are added to the Jackhammers. Drilling and blasting is carried on in this way until the level of the spoil in the shaft reaches the work level. By this time, enough rock has been chewed away to enable a crew to hand muck.

At length, after the headings have been advanced sufficiently and the workings benched down to the ultimate floor line, there is room for mechanical equipment. The first units to go underground are overshot muckers. In later stages, tractors equipped with front-

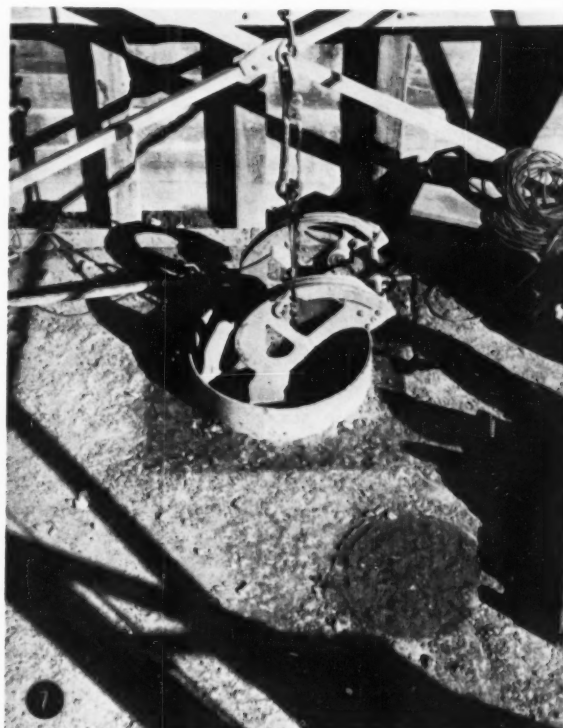
end shovels are taken in. Getting the muckers and shovels down the 42-inch shafts is no easy task. It requires the disassembly of each into quite small parts, and their reassembly in the cramped quarters underground.

The muckers operate at the foot of the shaft and are positioned on narrow-gauge track that runs only a limited distance away from it. Spoil is pushed to the muckers by the tractor-shovels. The waste rock is scooped into a mine can riding on a trolley pulled behind the muckers. After a can is filled, it is backed to the shaft where a hoist picks it up and carries it to the surface.

The hoist is housed in a head frame and is positioned alongside the axis of the shaft so that the operator can take care of dumping the buckets. When a can reaches the top of the tippie, the operator closes a combination barrier flap and chute that keeps the muck from falling down the shaft. Then he attaches a fixed line to an eye on the bottom of the bucket and lowers the bucket with the hoist until it is up-ended, thus dumping the muck into the chute. Dozers pick up the spoil from the pile at the foot of the chute and spread it out to fill the area in which the work is being carried on.



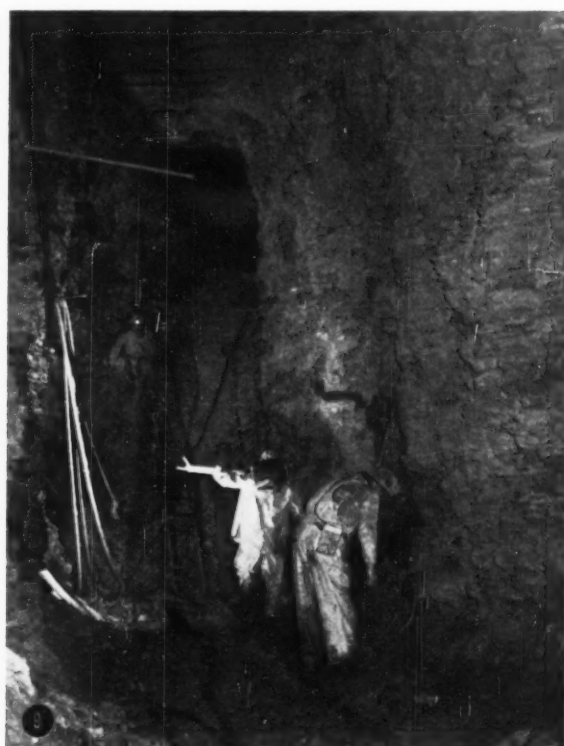
followed shortly by this tractor-shovel. The units are taken apart on the surface, and the parts . . .



sent underground through the 42-inch shaft. At the foot of the shaft, this equipment . . .



is reassembled and put to work. Actual mining underground is done by advancing roof-line drifts with the Jackleg drills . . .



forming a working area, such as the one shown in this view, and then benching the remaining rock to the floor line.

Bubbles, Breakwaters and Brasher

G. R. SMITH

STILL another chapter has unfolded in the story of the pneumatic breakwater. This device was born in the mind of an American, Philip Brasher, in about 1902 but was never really put into extended use until this year when a London company, Pneumatic Breakwaters Lim-

ited, installed its experimental design at the busy port of Dover, England. Even this application is not a permanent one.

The new installation—nearly identical in principle to compressed air breakwaters before it but with a new wrinkle

—consists of a system of underwater pipes that emit large air bubbles upwards to the surface. The purpose of the air is to disturb the harmonic action of incoming waves and reduce their size. This in turn greatly diminishes the power of the waves as they pound into ports or ships attempting to dock in these battered harbors. With this system, about a 50-percent reduction in the height of waves occurs. Because the energy of a wave varies as the square of its height, the breakers lose about 75 percent of their strength.

Two Lines

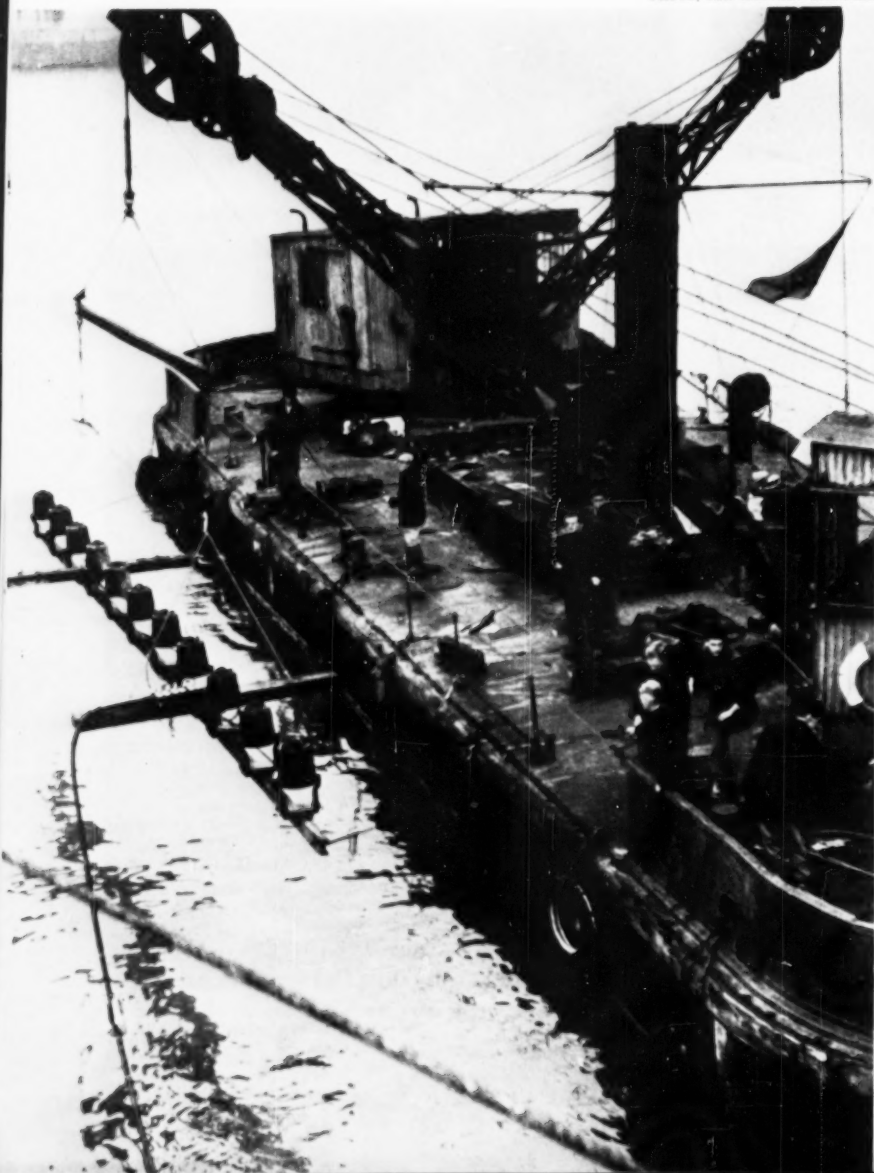
At Dover two parallel lines about 100 feet apart were placed across a 300-yard gap between two jetties. In their position on the sea floor, the lines offer the extra advantage of creating an effective wave dampener that doesn't obstruct sea traffic.

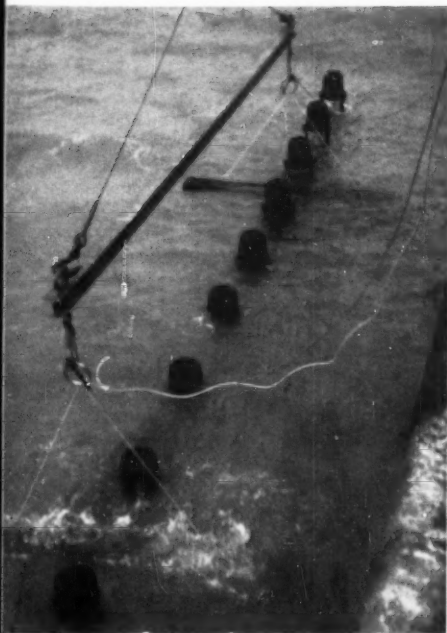
Beginning ashore the system works like this. Air is compressed by a battery of six 500-cfm compressors supplied by the British War Department (which sees possible military applications for the breakwater). These surplus machines have had their output reduced from 100 to 30 psig because higher pressures are not needed. Main manifolds of polyethylene receive the air from the compressors and distribute it to 1½-inch header lines that carry it several hundred feet along the sea bottom to the air distributors. These distributors are the principal new feature. They are special, jug-shaped polyethylene units that stand on legs made of ordinary rail chairs. The chairs are anchored to 45-foot lengths of standard railroad rail. Experiments have indicated that seven of the distributors is the optimum num-

LOWER AWAY

With eleven polyethylene distributors aboard, this section of rail is about to be lowered to its position on the sea bed. The line running to the bottom of the picture from the distributors' manifold is a header line. It connects to the main manifold ashore. Experiments found that seven distributors worked best.

PHOTO, THE MILITARY ENGINEER





PHOTO, THE MILITARY ENGINEER

INTO THE DRINK

A section of distributor "jugs" nearly submerged. When they are in place, air entering the bottom of the units forces out a volume of water. Then the air bursts out as a bubble to rise to the surface, making waves smaller by interrupting their harmonic action.

ber for such a rail, though as many as eleven have been tried.

From shore, a header line runs to each individual 45-foot section and joins a small manifold. Here, $\frac{1}{2}$ -inch branch lines feed air directly to the jug distributors. Air enters the bottom of the polyethylene vessels to find a water-filled chamber 2 inches in diameter by 10 inches high. After evacuating the water from the cavity, the compressed air belches out as a large bubble. As the waves gain in size, the time interval between bubbles is decreased by adjusting the shore controls. The average time interval is about 7 seconds. At Dover waves rarely reach more than 12 feet in height and 80 feet in length.

"Well-Executed Tackle"

As it rises to the surface, the bubble, in effect, "knocks the legs out from under the waves," an action that has been described as being similar to a well-executed tackle in a football game. Besides sabotaging the waves' underpinnings, the bubble also creates vortexes of air and water that swirl upward to further weaken the combers.

Each section of 45-foot rail has two railroad ties mounted on it at right angles to the rail. One tie is positioned about one-third the way in from one end and the other is placed the same

distance from the other end. These sleepers give lateral stability, whereas the rail forms a sort of keel that lodges in the sea bed. Small air vessels attached to each section of the breakwater act as either floats or sinkers. Filling these with air raises a complete section, and allowing water to enter the vessels forces the unit to the bottom.

A complete section including rail, sleepers, distributors and distributor legs weighs about 1 ton. All components in the pneumatic breakwater that handle air—lines from the compressors, main manifolds, headers, small manifolds, branch lines and distributors—are made of polyethylene. This plastic is flexible, lightweight and almost indefinitely resistant to salt water corrosion and marine organisms. If the installation were to be a long-time one, undoubtedly more permanent components would have been put in place of second-hand railway parts used because of their availability.

Improved Breakwater

The breakwater is an improved version of one that Pneumatic Breakwaters built after the company was originated in 1952 to experiment with air as a means of leveling waves. This early system was a conventional one that used perforated steel pipe and emitted a nearly continuous stream of bubbles to the surface. It was this type which the American, Philip Brasher, spent many thousands of dollars and nearly half a century promoting, but which for some reason was never widely adopted, despite the fact that it almost always worked successfully. It has been theorized that, in the past, its idea was too simple to be credible. Possibly it



PHOTO, THE MILITARY ENGINEER

CRANE ON QUAY

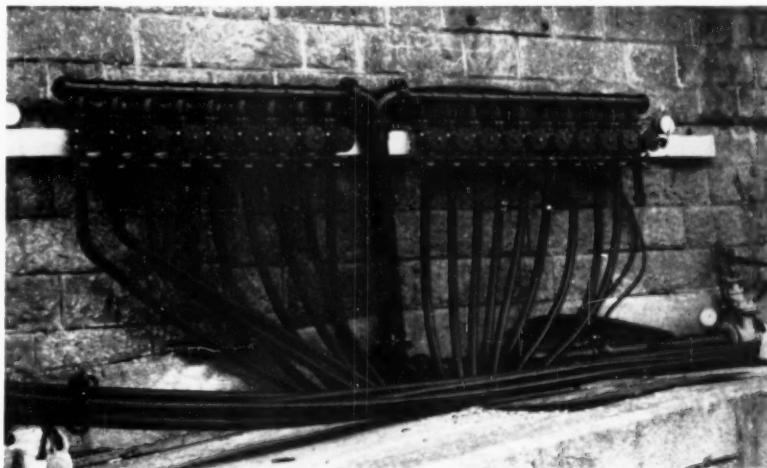
A mobile crane moves this distributor section along a quay at the port of Dover, England. Except for the polyethylene air-carrying lines, most of the breakwater parts were made from inexpensive second-hand railroad components.

didn't seem feasible that a mere string of bubbles could replace breakwaters made of sturdy rock or piles. The publicity received by Pneumatic Breakwaters Limited's polyethylene system may be an indication that man's technological thinking is now ready to accept the idea.

MAIN MANIFOLD

This is the main manifold ashore that controls the feed of air to the submerged 45-foot sections. Air from compressors enters the large pipe in the center of this manifold and passes into the many $\frac{1}{2}$ -inch header lines. Each travels several hundred feet under water to join with a small manifold on a 45-foot unit.

PHOTO, THE MILITARY ENGINEER



THE STRANGE VOYAGES OF THE VASA

PETER SLEIGHT

TWO sailings, 331 years apart, constitute the bizarre log of the Swedish man-of-war, *Vasa* (*Wasa*). The first voyage lasted but a few hours on a sunny August afternoon in 1628; the second for 28 days during August 1959, although it covered even less distance than the first. At least one more journey is yet to come for this vessel from out of the past.

When Sweden's King Charles IX died in 1611, he left his eldest son, 17-year-old Gustavus Adolphus, a powerful kingdom and three unfinished wars, including a long-term conflict with Poland. Adolphus took an active part in the campaigns, becoming one of the foremost military strategists of the seventeenth century. He considered the navy an important arm and built four new ships, of which the ill-fated *Vasa* was one. The bulk of the fleet was divided into two squadrons, one of which was given the mission of blockading the Polish coast. It was as flagship to this squadron that the *Vasa* was destined.

On that fine Sunday afternoon, August 10, 1628, the *Vasa* took aboard her arms,

munitions, and provisions, hoisted the squadron commander's flag, and set sail under the direction of Captain Safring Hansson. She plied an easterly course to join the squadron in the Stockholm Archipelago, from which she was to lead the group to Swedish possessions in Germany. The wind was light and southwesterly, and the *Vasa* carried only topsails and mizzen. When she passed the protective high rocks that form the southern coast of the harbor, a sudden squall heeled her sharply to port. To counteract the list, Chief Ordnance Officer Erik Jonsson ordered the guns moved to the windward side of the ship, but the order was apparently given too late. Water had already begun to flood the lower gun ports (open for a still unexplained reason). At 5 pm, the pride of the Swedish fleet capsized and sank in 18 fathoms of water while horrified spectators watched from shore. Between 30 and 40 men were lost from the complement of 130 sailors and 300 soldiers as she settled to her grave.

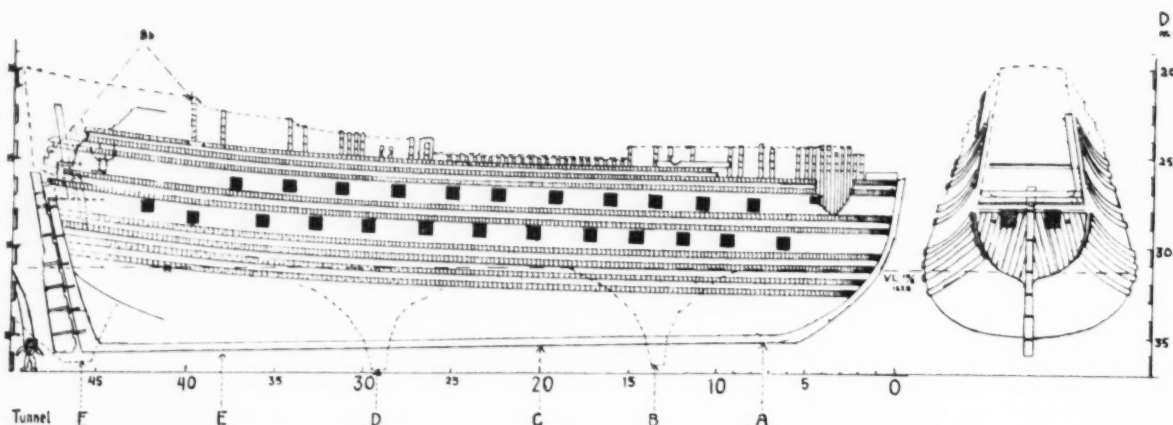
The vessel was christened *Vasa* at her launching in 1627, undoubtedly in honor

of Gustavus Vasa who came to the throne in 1523 (Sweden had previously been a province of Denmark) and who marks the beginning of the country's military history. She was completed in 1628.

Henrik Hybertsson, chief naval architect, had designed the ship, and the plans had been approved by the king himself. The *Vasa* was an attempt at a faster, more heavily armed vessel than had previously been built. A 2-deck ship of about 170-foot length and 40-foot beam, she draughted 15 feet. Her length-beam relationship of four-to-one proved to be most critical. Although later ships were built with lengths as great as three and one-half times the beam, their draught was greater and they had correspondingly greater ballast than did the *Vasa*. Her maiden-voyage disaster is attributed to the fact that she was too narrow for her heavy armament, too sharp of keel, and of too little a draught to give enough ballast capacity.

The man-of-war carried 64 guns, totaling 80 tons. These were divided into the principal armament and the lighter

WASA Dec 1958



SEVENTEENTH CENTURY MAN-OF-WAR

The sketch above was made less than a year after it was determined that the oak hull found belonged to the "*Vasa*."

Many of the details of the ship were not included because of her murky grave, but the nine hull wales are quite clear.

guns. The 48 pieces in the former group were 24-pounders of bronze alloy, 90-percent copper and 10-percent tin. They were divided into two batteries—22 of the cannons in the upper and the remainder in the lower. Of the 48, all but two were cast especially for the *Vasa*. The sixteen lighter guns, it is assumed, were placed on the upper deck, the poop and the forecastle.

She was built of oak with some fir planks in the bulwarks and superstructure. Her ribs and beams are 10 to 12 inches square. The planks of her hull meet flush (carvel-built) and are braced with a system of longitudinal wales of about 4 inches greater thickness than the planks. The wales are indicated on the line drawing at the bottom of page 22. Most of the joints are made with wooden pegs and are still intact. Where iron bolts or nails were used, the fasteners have, for the most part, rusted out.

As opposed to the hull, the bulwarks and superstructure were clinker-built—that is, the planks overlap each other clapboard style. They and the rigging have been almost totally destroyed by salvaging attempts and the currents beneath the harbor surface.

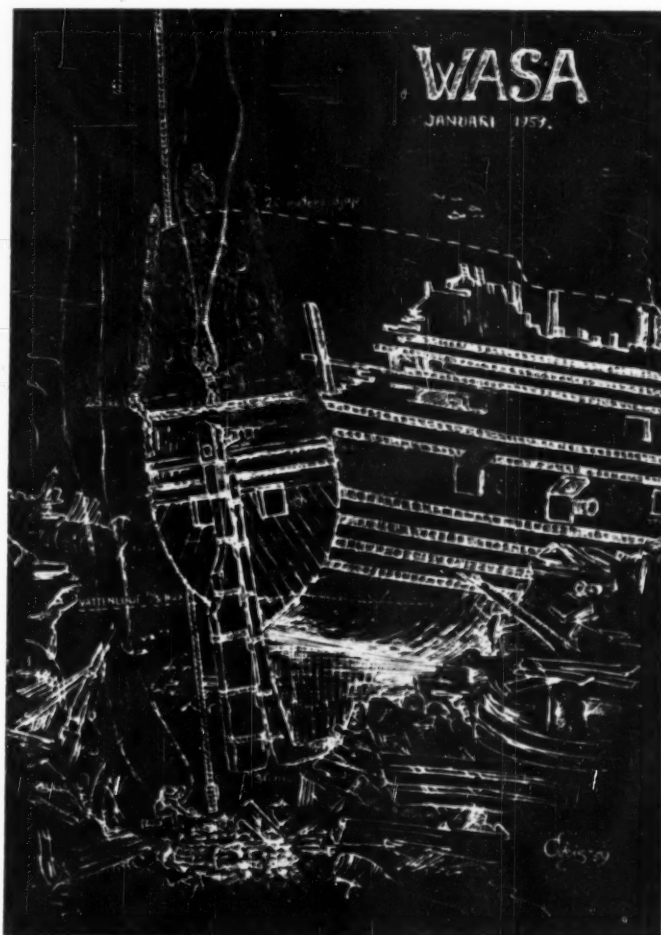
The oak is in excellent condition and Commodore Edward Clason, chairman of the present *Vasa* Committee, reports that it has a tensile strength of about 60 percent of fresh oak. Because there are no teredos (shipworms) in the Baltic, the wood has not been damaged from gnawing and boring.

Many attempts have been made to lift the *Vasa*. Most have been well-chronicled and are being brought to light in current research being carried on by many naval experts, foremost of whom is Lieutenant Commander G. Hafstrom. All the attempts have been unsuccessful until now; and it is still too early to know whether or not the current one will succeed.

The first try to recover the warship, its cannons, cargo, and money, took

place just 3 days after the catastrophe. It was headed by Ian Bulmer, a British engineer. He managed to put the ship on an even keel, but could not raise her. His work was of great importance, though, for the fact that the *Vasa* was resting on her keel has made today's operations easier.

A year later, the Swedish navy made an attempt. Divers were used, but the lifting gear was not strong enough and work was abandoned as were attempts in the following years. Much of the salvage gear was lost, only to be recovered by later adventurers.



In 1663, Colonel Hans Albrecht von Treileben used a diving bell and salvaged most of the guns. It is thought that he is responsible for many of the broken upper decks. An account of the work has been recorded in vivid detail by the Italian priest and explorer Francesco Negri in his *Viaggio Settentrionale*, published in Padua in 1700. He was on his way to North Cape (Nordkapp) Norway, the northernmost point in Europe, and stopped at Stockholm in 1663. Negri tells of divers dressed in flexible, watertight leather suits. They used

diving bells that were a little more than 4 feet high. Each bell was equipped with pieces of lead that hung 20 inches under the rim of the bell. The diver would stand on these when lowered to the wreckage. Because of the limited air supply, a diver could work only 15 minutes. Later, techniques were improved. Air was passed down to the bell in wooden casks, allowing the diver to work 30 minutes at a time.

Work was carried on in almost total darkness, for Maelar Lake, which has its outlet through Stockholm, is deeply brownish in color. By 1665, it is estimated some 53 guns had been retrieved. Another was brought to the surface in 1683, and one more came up last September.

By the close of the seventeenth century, the *Vasa* had almost become forgotten, although there is some mention of her in books about Gustavus Adolphus.

Then, in 1920, thoughts once again turned to the warship. Some unidentified guns had been found in the archipelago and were raised. A prominent Swedish historian was asked to date them and find their origin. While looking through old documents, he uncovered reports of the *Vasa* and published them. Andres Franzen, who specialized in locating naval wrecks, enthusiastically took up the search in the archives of the Admiralty and by systematic soundings of Stockholm harbor, located a big hull built of old oak.

That was in 1956. Divers verified the hull as that of the *Vasa* and salvage work began anew.

When found 3 years ago, the *Vasa* was silted to the lower battery gun ports, leaving only 15 to 20 feet of the ship above the mud. Naval officers, archaeologists, and experts in salvage and preservation were formed into the *Vasa* Committee, and divers were oriented at the Naval dockyard. Work began on September 5, 1958.

A 24-pounder was raised and it revealed a crest of the *Vasa* dynasty, the

year 162(?), and the letters *GARS* (Gustavus Adolphus Rex Sueciae), conclusively indicating that this was the sought ship and that the cannon was one of the 46 pieces manufactured especially for her.

Raising the *Vasa* was not easy. The water that surrounds the ship, like that of all the harbor, is muddy. With a lamp, it was possible to see about 4 yards, but when the silt was disturbed, which was easily done, nothing could be seen. The sketch that appears on page 23 was made in January 1959 from numerous details that were laboriously recorded under these circumstances. Although it is authentic, Commodore Clason is quick to warn that it must naturally contain many inaccuracies of detail.

Mud surrounding the warship was pneumatically sucked ashore and carefully strained for each bit of historical information it contained. Nearly a thousand articles have been recovered and the committee says that undoubtedly more will be found. An exhibition of some 200 of the finds was held in February of this year at the Museum of Marine History, Stockholm. It included the 10-foot cannon with its decoration (and the rudder, which was removed so that it would not damage the ship when the *Vasa* was moved). The balance of the display consisted mainly of carved wood ornamentation.

The sculpture is of great artistic importance since it furnishes a picture of the art of the period which has been

little known. A Swedish-developed polyglycol method of preservation has been used to restore the original color of the wood, make its grain structure stand out clearly, and to prevent further deterioration. According to Commander George Hafstrom, who has made an extensive search of the archives concerning the *Vasa*, six master carvers were employed by the Admiralty for adorning the vessel. Subjects were chosen from mythology and the animal world, some of such intricate symbolism that even experts are puzzled as to their significance. For example, one item uncovered is a man's head with bunches of grapes in its mouth; another shows a man's head with snakes coming from its mouth and nose.

To lift the *Vasa*, six tunnels were first driven under her. Air was furnished for this operation, as well as for the pumping, by a 200-cfm compressor discharging at 100 psig. Commodore Clason also found this to be an adequate air supply for the divers.

When the tunnels were completed, twelve cables of Fagersta steel were slipped through them and beneath the ship. (The position of the tunnels is indicated in the sketch on the first page.) The raising was done from two heavy salvaging pontoons loaned to the *Vasa* Committee by Stockholm Neptune Company and under the direction of Captain Axel Hadberg. It was a tricky operation. All the cables had to be tightened equally and simultaneously so not to capsize the vessel again. It was feared

that the cargo would shift with the movement and make further lifting in an upright position impossible. Because of this, and because a rapid change of water temperature and pressure might destroy the prize, the lifting was done gradually. Pumps operated at 10-minute intervals, increasing the lifting power by 100 tons at a time. Soon the stern rose a few inches, and the *Vasa* was free from her berth.

Next, the warship was turned 90 degrees to a crosswise position and raised to a depth of 56 feet. Then began her second voyage. She was towed toward Kastellholmen shore at a speed of less than 100 feet a day. After 28 days, work stopped for the winter. It will resume next spring. Eventually the *Vasa* will be docked at Galarvrevet, which will form a permanent museum both for the vessel and the other items recovered during the salvage work.

If successful, the operation will be of great significance not only to Sweden, but to all naval architects and historians. Older ships have been recovered, including Egyptian, Roman and Viking vessels; however, the *Vasa* is the oldest fully identified man-of-war in such good physical condition. Not only is she well preserved, but the records of her construction are precisely dated and detailed, as are those of her crew and equipment. Old records of salvage attempts are equally lucid. When the restoration is completed, estimated to be in the 1970's, man will once again have triumphed over the sea.



This and That

Making Saltier Salt Water

Adding salt to the ocean seems a useless activity, yet it is being done by a unit recently shipped to Japan by Ionics, Inc., Cambridge, Mass. With no active salt deposits, Japan is dependent on the sea for her salt. Imports of the vital seasoning are under strict governmental control to conserve foreign currency. The Ionics unit is designed to produce a concentrated brine stream carrying 1 ton per day of salt and is considered a pilot unit for future large-scale installations. The sea-water concentration unit differs little from electrodialysis units designed to convert sea water to fresh. The latter type discharges a large stream of

waste water slightly enriched in salt and conserves a smaller quantity of fresh water as the end product. The salt-making unit produces a small primary enriched stream of brine while wasting a large stream slightly depleted in salinity. Costs are expected to be commercially feasible.

★ ★ ★

Recent Research Results

A unique chemical compound called sulphur tetrafluoride, whose very existence was doubted in scientific circles until recently, has been placed on the market in development quantities by Du Pont's

Dyes & Chemicals Division. The new product is a reactive gas that, unlike other reagents, possesses the unusual ability of replacing oxygen with fluorine in many chemical compounds. In light of the wide-spread interest in fluorinated products in recent years, this quality is particularly significant since it will now be possible to offer a large number of fluorinated compounds heretofore unavailable. Sulphur tetrafluoride appears to be of particular interest in pharmaceutical products, where addition of fluorine has been known to result in drugs of high potency. The ability of fluorine to cause or modify biological activity of other chemicals might also lead to better insecticides and herbicides. Other uses may well be in the production of improved weather-resistant finishes, and oils, films, plastics, and elastomers with high thermal stability and resistance to oxidation. The low surface energy characteristic of many fluorinated compounds also suggests use of sulphur tetrafluoride in the manufacture of surface active agents, water and oil repellents, and lubricants.

Light Touch For Tooth Grinding

New high-speed dental drills including the air-operated type which turn at several hundred thousand rpm, work so fast that it has become important for dentists to have some qualitative means of knowing the difference between a light touch and a heavy hand. Researchers from New York University's Colleges of Dentistry and Engineering worked together on the problem and devised an instrument to measure the pressure exerted by a dentist on his drill. The device is attached to the drill and measures pressure by means of minute strain gauges arranged radially about the drill handpiece. The pressure signals are transmitted to a continuously moving pen-scribing recorder, thus giving the dentist a constant, objective appraisal of the amount of pressure he is applying. The researchers hope that their instrument will eventually be incorporated into standard dental units. The research was sponsored by a grant from the U. S. Public Health Service intended to help fix treatment standards in the dental profession.

★ ★ ★

More Rain In Cities?

There is evidence to support the theory that rainfall is heavier in urban areas than in sparsely settled districts. Dr. Glenn E. Stout reported to the Conference on Weather Modification by Artificial Means, that in 1957 there was 18 percent more precipitation in the central or urban part of the Champaign-Urbana, Ill., area than in the less populous parts of the study district. The so-called urban effects that he believes may cause the heavier rainfall are increased turbulence from local heating, greater mechanical mixing of the air and a greater concentration of condensation nuclei, in addition to increased water vapor from combustion processes. Reports from other sections of the country seem to bear out the theory, although there is speculation that precipitation gauges might collect more rainfall in the shielded areas of the city than they do in the more open windswept countryside.

★ ★ ★

Atomic- Powered Blimp

America's first nuclear-powered aircraft may be a 4.5-million-cubic-foot nonrigid airship, about three times the size of blimps currently in use by the U. S. Navy as sentinels against submarine and aerial attack. Goodyear Aircraft Corporation informed the Navy Department that such aircraft are practical to meet military requirements, and the proposed ships could be operational by

1963. Capable of 70- to 80-knot speeds, the ships could reach any point in the world from existing bases in the United States, operating at altitudes of 10,000 feet. Due to the blimps inherent buoyancy, its power requirement is considerably less than that of conventional aircraft. Thus, the reactor required would have only one-twentieth the power needed to sustain a nuclear-powered heavier-than-air craft. Further because of its small size, special ground-handling equipment would not be needed. The Goodyear Tire & Rubber Company has made the fabric for the craft—a Dacron cloth, coated with adduct synthetic rubber to resist radiation. The ships would be 540 feet long, thus the danger from radiation from the atomic reactor would be no greater than in an atomic plant.

★ ★ ★

Watch Fob Collector

For years one of the favorite gifts of contractor equipment dealers has been one form or another of the ubiquitous watch fob. Perhaps one of the reasons for its popularity with customers is that wrist watches are not always practicable in the dust- and dirt-laden atmosphere around most heavy earthmoving and rock-drilling operations. Seventeen-year-old Larry Yartz, R. D. 1, West Sunbury, Pa., has a collection of 612 different fobs, as well as duplicates that he uses for trading. His hobby began 7 years ago when a family acquaintance gave him a number of old fobs including some bearing representations of air compressors. The oldest fob in the collection dates from 1893. Others were issued in 1909, 1911 and 1915.

★ ★ ★

Nonstop Filter Press

A British company, Sanderson & Murray, Ltd., is producing an automatic, self-cleaning, liquid-extraction filter press for liquid-solid suspension applications. The press operates without manual control and can run continuously. It will treat materials varying from semisolids containing fluids such as water and oil, to fine suspensions with as little as 1-percent solid entrainment. Peat, distillery residues and fine inorganic slurries have been handled successfully, it is reported.

The pressing agent is an inflatable bellows assembly that is pneumatically operated for pressures to 150 pounds per square inch, and hydraulically for pressures above this and to 450 pounds per square inch. (These are direct operating pressures on the material, equivalent to 84 and 252 tons, respectively, over the total pressing area.) In the case of semisolids, the material is fed

automatically into the press between two filter cloth conveyors. If the material to be treated is a complete fluid, the charge per stroke of the press is automatically injected between the two filter cloths under the bellows assembly before each pressing stroke. A seal arrangement, which is operated by the bellows, contains the charge, while the bellows assembly inflates. The seal is effective throughout the whole pressing stroke. Controlled by an electric timer, the charge is subjected to a preset operating pressure for a given time. The liquid, filtering through the cloths over the top and bottom surfaces of the charge, passes to a collecting trough when the pressing is finished, and the bellows automatically empties and retracts upwards. The conveyor system is then set in motion, discharging the material from which the liquid has been extracted. The filter cloth conveyors are then back-washed, using water, steam, or compressed air.

Our Bagpipe Bungle

WITH characteristic unanimity of purpose Scots readers from all over the world have written in to heap coals of (Gaelic) fire upon our heads for having dared to suggest, as we did in the caption to the cover of the June issue, that the Black Watch piper could be a member of an "English" bagpipe regiment and furthermore, that he was standing on a battlement of Edinburgh Castle.

That he was standing on Calton Hill is relatively unimportant in the face of the former point which rankles in the minds of Scots to whom the memories of Bannockburn, Flodden and Culloden Moor are still sacred!

To have the tartan and the tongue associated with the appendage south of the Tweed we now know is indeed acrimonious but we trust that the sons and daughters of Old Caledonia will forgive our lapse and attendant lack of appreciation by we Americans and others, of the finer points of Scottish history.

Note: We received so many letters from Scots the world over that we thought it best to let one of these gentlemen write our correction for us. The foregoing was written by a reader in Johannesburg, Transvaal, South Africa. We agree fully with him and offer our apologies to all concerned.

**Processing Photos
Washing Gorillas
Growing Orchids
Printing Money**

All in a Day's Work

HYDROGUARD is a thermostatic mixing valve that was introduced more than 30 years ago to overcome all-too-familiar problems of scalding and freezing in commercial and institutional showers. Now it is finding new and widely diversified applications in heart surgery, the printing of money, the molding of plastics, growing bean sprouts and orchids, and washing gorillas.

A product of Powers Regulator Company, Hydroguard was developed to blend hot and cold water and, more important, to keep it at the desired temperature. With the original equipment, water flow is stopped whenever the temperature of the liquid goes above 110° F. Sales reports for this shower application indicate that it is still an important one, but the device is being put to other uses.

The most recent application of Hydroguard was as an aid on a blood heat exchanger developed at the medical center of Duke University, Durham, N. C. The exchanger is used when a patient's heart must be by-passed while a surgeon operates on it. The job of the blending device is to cool the blood, thereby improving the ease and safety of the operation. Hot and cold tap water are piped into the valve that mixes the water to the desired temperature. The regulated water is then circulated around a coil of tubes carrying the blood, maintaining its low temperature.

A greenhouse in Memphis, Tenn., was the site of another application—that of growing orchids. As amateur horticulturalists know, chilled water will kill this tropical plant. The Hydroguard simulates rain-forest conditions by keeping sprinkling water at the right tropical temperature. In one instance, a grower has reported that on 150,000 seedlings raised annually, losses of the precious flower were cut by 98 percent.

Similar findings have been made at chop suey supply houses in Philadelphia, Pa., and Los Angeles, Calif. The bean sprouts used, when properly watered, stay tender and grow rapidly. Hydroguard did the job.

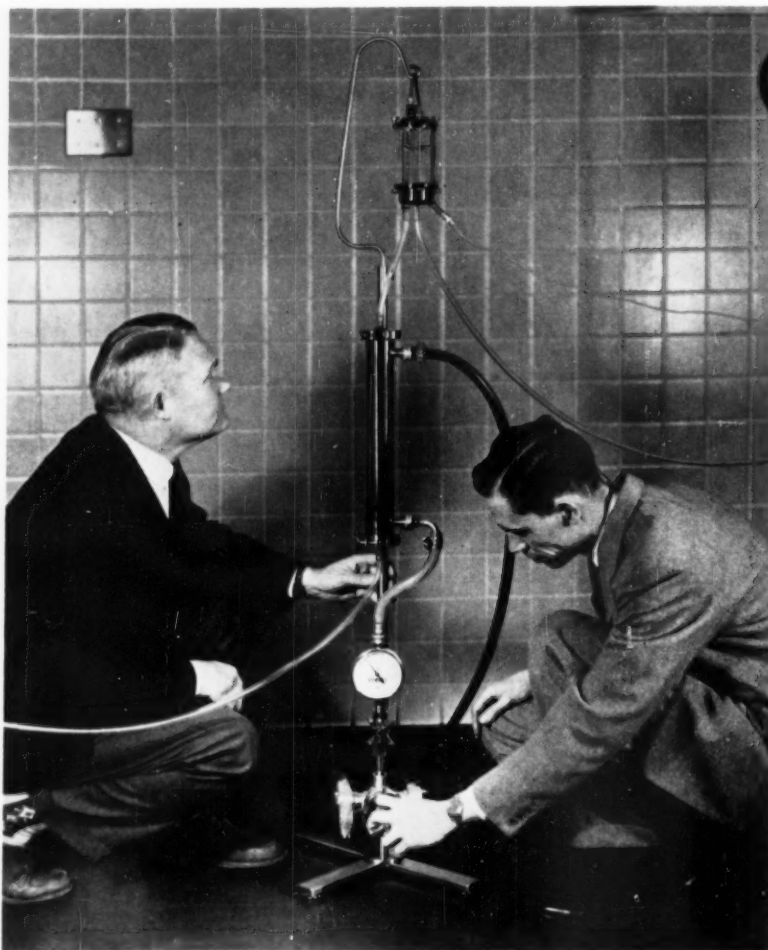
Several plastics molding firms use the control to provide tempered water to injection molders. In Ann Arbor, Mich., a camera manufacturer uses it to speed the rinsing of polishing rouge from lenses. Again in the humanitarian realm, a chicken packer in Doylestown, Ohio, installed a unit to keep workers'

hands from stiffening in the cold rinse water. The U. S. Bureau of Engraving makes use of the device to warm the ink used in its daily printing of \$480,000 worth of silver certificates.

The manufacturer has noted that commercial photo-processing firms that specialize in color work will find such a device of particular value. The mixer regulates the temperatures of processing solutions. Variations in temperature of

plus or minus 1° F can ruin a negative; the Hydroguard reportedly holds the mix well within the safety limit.

Turning from the practical to what seems to be the most unusual application, keepers at Lincoln Park Zoo, Chicago, Ill., use the control to regulate the daily showers of its gorillas so they don't chill and catch pneumonia. Hydroguard is doing more than its share of duties, and its future is limitless.



HEART SURGERY AID

Members of Ward Laboratories, Inc., inspect a blood heat exchanger, developed to aid in heart surgery where the patient's heart must be by-passed. Blood passing through the exchanger is cooled by water thermostatically regulated by the Hydroguard mixer. The valving at the bottom of the device does the job. Hot and cold water are blended and delivered at a plus or minus 1/2° F of the desired temperature.

EDITORIAL

Steel



MAKING steel is so basic an industry that there is, perhaps, no other commodity quite of its importance in heralding the advance of a nation's industrialization, its progress in the output of

material luxuries and even its economic well-being. Today, the United States has an annual steelmaking capacity of 147.6 million tons—more than any other nation in the world. The growth of this huge industry in the more than 300 years since the nation's first successful iron-making venture at Saugus, Mass., is one of the outstanding tales of technology.

This country achieved its preeminence in steel in 1890, surpassing Great Britain for the first time. At that time, the U. S. had an annual output of 4.28 million tons, more than one third of the world's total 12.28 million. By 1920, the nation produced more than half of the world's supply, a condition that prevailed through most of the twenties. (Today, 28 percent of world capacity belongs to the United States.) Production records were set annually in those roaring years and 1929 showed a 500-percent increase in output over that at the turn of the century.

The depression years came—steel output dropped to a level just 30 percent greater than 1900. In the era of recovery, steel bookings were an almost infallible indicator of national well-being. A look at orders was practically all that was needed to predict the state of the stock market in months ahead.

TWENTY-FIVE years ago, steel began to come out of the depression. In 1934, output struggled up to slightly less than half of the total capacity of 78.1 million tons. In only five of the years since has capacity taken a backward step. It climbed to more than 100 million tons annually for the first time in 1950. Production, more susceptible to short-term cycles than capacity, dropped back 11 times in the same interval, still, however, climbing to an all-time record of 117 million tons in 1955.

During that 25-year span more than 2 billion tons of raw steel poured from the furnaces of the industry. To attain that astronomical figure required the expenditure of some huge sums of money. By the end of this year, the industry will have an estimated \$14.75 billion invested in capital equipment. In each of the last 4 years more than \$1 billion was put into the tools and buildings that make up the physical plant of steel. Only twice before—in 1951 and '52—did investment rise to such heights.

TECHNOLOGICAL advancements in the last quarter century have been great. Such things as controlled cooling on a production basis,

induction hardening units for commercial use, electrolytic tin plate mills, continuous galvanizing equipment and the first use of oxygen in making electric furnace stainless steels came about in the 1930's.

Over the war years, records in production were set annually. Experiments were carried on utilizing oxygen enrichment of blast air in blast furnaces, and with methods for putting top pressure on blast furnaces to increase the amount of oxygen available for reduction of ores. In post-war years, oxygen steelmaking came of age.

The 1950's have been, perhaps, most important from the technological viewpoint. The vast deposits of the Mesabi range began to give way to ores imported from abroad. Taconites, it was found, could be successfully mined and enriched for use in furnaces. Great undertakings aimed at developing the rich taconite deposits of the North Central states made industrial news. Vacuum melting of steel became prevalent, first in the manufacture of superalloys for missiles and rockets and then, today, in the making of steels for more prosaic uses. Electronics entered the production field and punch cards are now used to control rolling mills. Other strides toward automatizing production have been made. This year, the basic oxygen steelmaking capacity grew to more than 4 million tons per year—a level at which the new method can be fully examined.

IMPORTANT beyond the point of passing interest, it seems to us, is the fact that among the great strides made by the industry in boosting production, the mention of oxygen occurs so often. It is, after all, one of the most necessary raw materials in the making of iron and steel. (The introduction of the first centrifugal blast furnace blower in 1913 brought far-reaching changes in the size and efficiency of blast furnaces, because it boosted tremendously the quantity of air and thus oxygen that could be blown through a furnace.)

Great strides in the development of machinery making it economically possible to produce tonnage lots of oxygen has in turn made it possible to use that oxygen in the making of steel. Oxygen enrichment of blast furnace air is now prevalent; the use of oxygen in the Bessemer converter is well established; and a new technique of making steel directly from iron ores by the basic oxygen process holds forth great promise for the future.

Vacuum melting is another of the great steps that depends on air and gas technology as is the development of large new primary blast hole drills that have made it possible to open extensive new deposits of iron ore. Indeed, we feel a large measure of the credit for steel's progress is due the manufacturers of air and gas equipment for having made available equipment to meet the needs of steelmakers.



SAVING
WITH
AIR POWER
APPLICATIONS

Wet-Blast Cleaning

A LARGE Chicago heat-treating firm has an especially critical time schedule for completing its work. Of all the jobs that come into the company's shops on any given day, an average of 80 percent must be done and ready to go back to the customer the next day. The customers, manufacturers of many products, need their parts back in a hurry so that the next operation can be performed on them. Any slowing down in manufacturing, such as this heat-treating operation, is naturally reflected through the subsequent stages and, eventually, means costly delay in completion of the product.

Because of the time element, an air-powered wet-blast unit is used in the cleaning of the heat-treating concern's work. Called the Model 43 Liquamatte wet-blast machine, the unit is manufactured by the Techline Division of Wheelabrator Corporation, Vicksburg, Mich. The machine's main feature consists of an enclosed metal cabinet about the height of an average man. There is an observation window at eye level and below are two openings into which an operator places his arms. These openings become flexible gauntlets that allow the operator to use his hands within the cabinet. Inside the cabinet is a turntable on which work is placed, a car moving the turntable, and a spray gun. Holding the spray gun in one hand, the operator can turn the table with his free hand, making sure the cleaning is thorough. The machine is designed for removing heat-treat scale, for surface cleaning, fine deburring, blending grinding lines, finishing dies, preparing surfaces for plating, and general cleaning.

With the normal $\frac{1}{2}$ -inch jet opening, the cleaning slurry spray is forced through the system with air at 100-psig pressure at about 80 cfm. A 20-25 hp compressor is recommended for this service. The air-entrained abrasive slurry falls through a coarse mesh below the turntable after being sprayed on

the workpiece. Then it is pumped to a storage tank to be used again.

On the front of the cabinet is a bank of push buttons for controlling the machine. To the right of the enclosed cabinet is a partially enclosed area that is used for rinsing.

The Chicago company uses the Liquamatte machine for cleaning die casting dies, metal cutting dies, forging punches and knockouts, gears and the like. The use of air power to force the abrasive slurry over these items gets the work done in the required short time. Further, the wet blasting extends die and mold life, reduces grinding operations and eliminates other costly finishing.

SPRAYS IT CLEAN

Abrasive spray spews out of the Liquamatte wet-blast unit's spray gun to clean this die. Powered by 100-psig air, the slurry quickly and thoroughly finishes precision metal parts at a Chicago heat-treating concern. The operator's right hand is holding the gun while his left positions the turntable.



Installing Rail-Car Bearings

A LEADING manufacturer of roller bearings needed a fixture to speed installation of an all-purpose freight-car bearing that is built to fit all existing types of rail-car truck frames. First developed was a hand-operated hydraulic unit that required from 8 to 10 minutes to install one bearing, and about the same time to remove the bearing.

This fixture worked, but was too slow. The company then adapted an Ingersoll-Rand 9RM 11 Air Motor to replace the manual power. The air motor drives a hydraulic pump that delivers 1.5 gpm of hydraulic fluid at a pressure of 10,000 psig. This high-pressure delivery results in 68.75 tons of pressure being applied to the bearing ram.

The use of the air motor cut bearing installation and removal time to 30 seconds—a saving of some 95 percent. (In one test, 40 bearings were removed from 10 cars in 30 minutes; with the old method, several hours would have been needed.) In addition to its speed, the I-R air motor is lightweight and compact, allowing the fixture to be portable for easy shop use.

Nitrogen From a Packaged Generator

NITROGEN constitutes 78 percent by volume and 75.5 percent by weight of the atmosphere and is readily available. Although colorless, odorless, tasteless, and incombustible, this inert gas has a list of uses that is impressive.

In the petroleum, chemical and paint industries, nitrogen is used to prevent fires and explosions, to treat synthetic resins, to adjust liquid batches in varnish cooking, and as a protective blanket for high-purity products. Metalworkers are familiar with this gas as a control for furnace atmospheres in annealing and heat-treating operations. Bright annealing of copper and its alloys is still another use. In electronics, nitrogen finds a job as a purge gas to flush air out of electronic equipment prior to sealing, as, for example incandescent light bulbs before they are filled with an argon-and-nitrogen mixture. It has been found that electrical equipment does not deteriorate as fast when it is stored under pressurized nitrogen as when kept in a normal atmosphere because of the high-insulation quality of nitrogen. The gas is also a carrier for heat and a dilutant for components of reaction. It even controls rodent and insect contamination of stored products.

Some industrialists purchase nitrogen in pressure vessels; others find it economical and convenient to manufacture their own by using an inert gas generator. Because compressors, purifiers, and storage facilities are required with this second method of obtaining

nitrogen, the manufacturers of generating systems find that buyers are coming more and more to rely on the manufacturer to furnish this accessory equipment with the generating units. What customers want is a complete nitrogen-producing package.

One generator manufacturer that is capably filling this need is Gas Atmospheres, Inc., Cleveland, Ohio. It will furnish a complete package that is ready to be mounted on a concrete foundation.

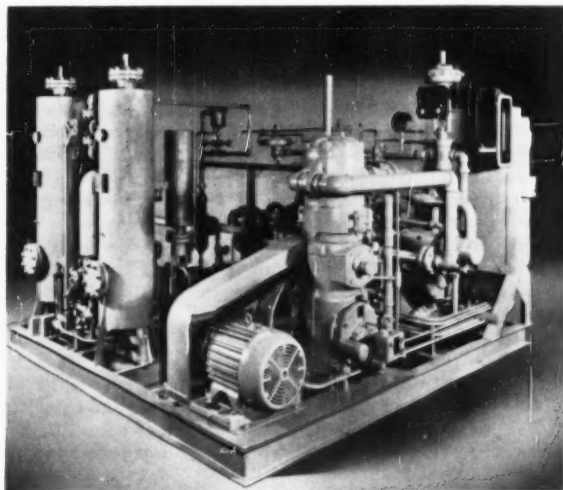
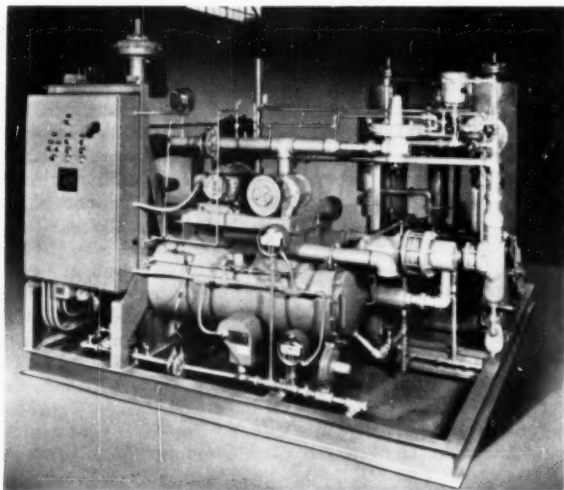
When a nitrogen-generating system is ordered, wiring and piping diagrams are worked out by Gas Atmospheres so that the required foundation pad and the necessary fuel gas, water, and electrical connections can be prepared by the customer in advance of shipment of the unit. Meanwhile, Gas Atmospheres erects the unit, adding any specified auxiliary apparatus. After final testing, the package is shipped as an integral unit under a single protective cover. The only field erection required is to secure the unit to the foundation, connect the utilities, and attach a few gauges and controls, such as delivery-line regulators and relief valves, that are shipped separately.

All equipment on a nitrogen generator is mounted on a common structural frame that requires a minimum of floor space. The units vary in size from approximately 3 to 17 feet in length, from 4 to 9 feet in width, and from 7 to 18 feet in height. They may weigh from 1200 to 25,000 pounds.

Certain pieces of auxiliary equipment are so frequently ordered that they are rapidly losing their status as "extras" and are taking their places with the standard equipment. An inlet gas pressure regulator or booster is obtainable if the customer's fuel gas pressure is above or below the required 44 to 52 ounces. A spring-loaded, diaphragm-operated delivery-line pressure regulator may also be specified to maintain a constant discharge line pressure from the generating unit to processing equipment. These are but two important controls and auxiliary parts obtainable.

Another group of "extras" include driers to remove moisture from the nitrogen, storage equipment, and compressors for increasing the gas pressure. All the compressors used are V-belt driven by electric motors. On the smaller inert gas generating units, they are Ingersoll-Rand 2-stage, air-cooled Type 30's, driven by 1- to 15-hp motors. The larger Gas Atmosphere units use I-R ESV compressors with electric-motor drives rated from 20 to 150 hp. The ESV units are heavy-duty vertical compressors that require a minimum of floor space, thus helping to keep the generator package as small as possible.

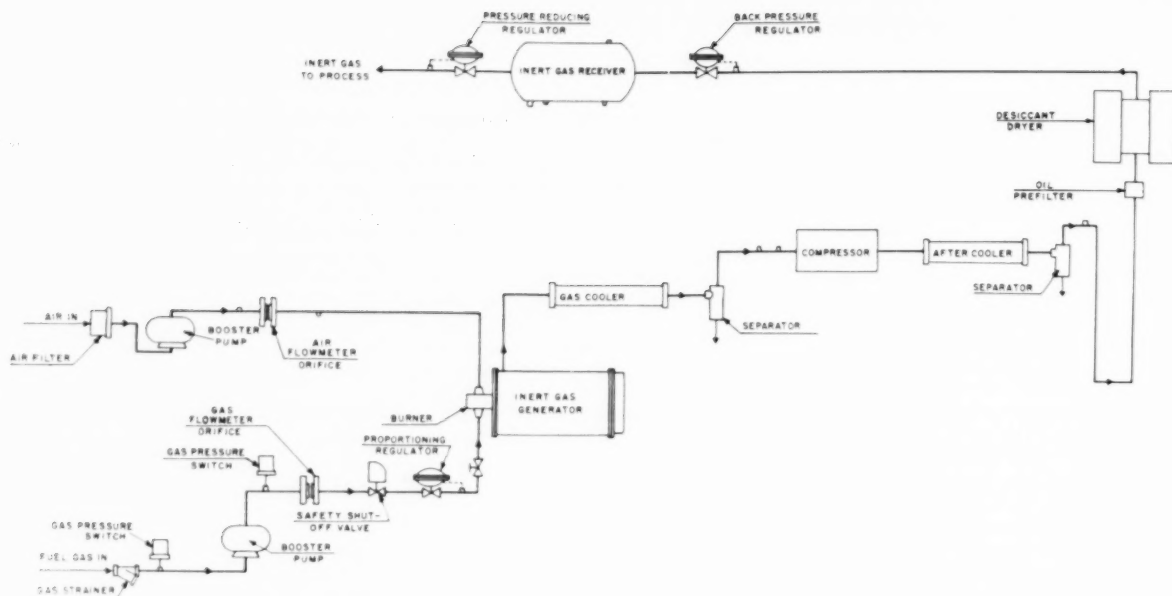
Each inert gas generator is equipped with a number of safety devices. Blower motors are totally enclosed and are fan cooled. A safety shut-off valve in the gas line, operated by a gas-pressure sensing switch is provided on standard units. Entire generator shutdown is



NITROGEN ON THE SPOT

The inert gas atmosphere generator shown requires an area of only 6' x 3 feet, with a 6-foot overhead clearance. Designated as Model XH-300, it incorporates an Ingersoll-Rand 6x5-inch, heavy-duty ESV-1 compressor, followed by a desiccant gas drier for high-pressure water removal to

a dew point of minus 60° F. Using 345 cfh of natural gas, 18 kw of power, and 28 gpm of water (based on a 30° F temperature rise), the package turns out a maximum of 3000 scfh of nitrogen at a cost of only \$0.27 per 1000 cubic feet.



A TYPICAL SYSTEM

assured when there is a burner flame failure; a loss of fuel, power or air pressure; insufficient cooling water; or where there is an overload of the air booster motor. A sealed Nozzle-mix-type burner eliminates the need for a fire check.

Operation

Gas production is a relatively simple process. It consists of three basic phases: preparation for combustion, combustion, and final cooling and drying for use or storage. Any commercial hydrocarbon fuel—natural gas, coke-oven gas, propane, butane and the like—may be used as long as it is furnished at a constant pressure of 44 to 52 ounces. Essentially, it is burned with air under pressure and yields 8.5- to 11.5-percent carbon dioxide and about 85- to 88-percent nitrogen, with a dew point of 10° F above the temperature of the cooling water used. By Orsat analysis, the atmosphere produced can be adjusted to contain 3- to 0.1-percent hydrogen and carbon monoxide each, depending on the product application involved. A uniform output analysis is assured because the generator includes a positive fuel gas-air-ratio control.

Air and fuel are independently cleaned, metered and controlled before being delivered to a specially designed Nozzle-mix burner where complete combustion takes place.

The fuel gas enters a strainer that screens out potentially harmful foreign matter. A booster pump raises the fuel pressure to 3 psig. Through a flow-meter orifice and shut-off valve,

the fuel proceeds to a proportioning regulator to obtain the proper balance with the rate of air flow. It then passes directly to the burner where it is mixed with the incoming air for combustion.

The air is filtered, and, like the fuel gas, its pressure is raised by a booster pump to 3 psig. The booster is generally of the belt-driven, positive-displacement type, equipped with a by-pass regulator that allows unrequired air to be returned to atmosphere. (Some units utilize a centrifugal belt- or direct-driven booster.) From the booster, the air passes through a throttle and flow meters before entering the burner.

Combustion takes place in a stainless steel, water-cooled firing tube, unlined to retard the formation of undesirable nitrogen oxide. It is surrounded and cooled by water, which should be maintained at a temperature below 130° F if mineral salt deposits are to be kept at a minimum. The temperature of the process gas in the combustion chamber is gradually reduced to less than 800° F, and it is passed off at about 500° F.

The resulting nitrogen-rich gas is directed through an indirect heat exchanger for final cooling to a temperature of 100° F or lower, as it begins the third and final phase of the generation process. As it enters a centrifugal separator, the velocity of the nitrogen flow is increased to 80 feet per second by means of a baffle plate. Condensed water from the combustion phase is removed through a condensate float trap and drain, and the nitrogen passes to a compressor-aftercooler system, an oil prefilter and a desiccant drier. (A back pressure regulator in the line main-

tains a 125-psig discharge pressure to hold stabilized pressure and flow conditions within the system.) From the drier, the nitrogen goes to a gas receiver where it is maintained at 100- to 120-psig pressure. Before use, it is passed through a pressure-reducing regulator so that a 45-psig pressure is obtained at the customer's process gas headers.

A Gas Atmosphere generating package can operate with a minimum of attendance because of its push-button control system. (Auxiliary equipment may be obtained to make the operation automatic.) All of the relays, controls, transformers (excepting the ignition transformer), and magnetic motor starters are mounted in a central control cabinet, and all piping and wiring is interconnected at the time of assembly.

Capacities for the entire line of inert atmosphere generators, designated as Models XH-25, XH-50, XH-100, etc., range from 250 to 100,000 scfh. They require from 0.5 to 29.0 kwh of power and 2 to 600 gpm of water, based on a 30° F water temperature rise. Natural gas is consumed at a rate that varies from 28 to 11,100 cfh, while propane is used at rates from 12 to 4600 cfh, depending on the model used.

Turning out nitrogen is inexpensive. In a typical example, using a Model XH-100 inert atmosphere generator, operating at a maximum output of 1000 scfh, the total production cost is only about \$0.17 per 1000 cubic feet of nitrogen. This figure is based on fuel costing \$0.65 per 1000 cubic feet; power at \$0.015 per kwh; and water, at \$0.19 per 1000 gallons.



Industrial Notes

GOLDEN THIEF is a lightweight vacuum pump said to be useful for sampling highly corrosive liquids when contamination must be avoided. Model D, illustrated, handles liquids as viscous as syrup, as well as powdered solids that have a tendency to slump. The lift of the pump is said to be about 25 feet of water at sea level. Material passes through sanitary tubing from the sampling source directly to the sample con-



tainer, and never comes in contact with any part of the pumping unit itself. Motive power is provided by the vacuum created in the sampling container on the up-stroke of the pump handle. The unit is available in both stainless steel and aluminum, and, since parts are interchangeable, can be furnished with a stainless steel base and aluminum body, or any combination of the two metals. The equipment fits neck-opening sizes from 22-millimeter diameter to wide-mouth mason jars. **W & W Manufacturing Company**, P.O. Box 9311, Chicago 90, Ill.

TELECONTROL, an electro-mechanical system for controlling production and boosting plant efficiency, is described in a 3-color, 6-page brochure, No. H-201. Much time is lost in manufacturing plants because of poor communication between workers and their supervisors, and between supervisors and service or production personnel. Telecontrol links each machine, each worker and each supervisor through a centrally located production control center. This center forms a single point for collecting and recording all production data and for directing plant activities. Five basic

elements comprise the system. *One*, a simple control box at each production station has a switch for the operator to signal the control center. Every operation of the production station is transmitted to the center. Also there is a telephone jack for direct control. *Two*, lightweight telephone handsets are belt-carried by authorized persons for 2-way communication with the center. *Three*, in the control center are time and piece counters which record production information from each station, such as production time, total pieces produced, down time, and balance to be produced. Audio-visual signals constantly show the production status. *Four*, a key operations recorder in the center charts operations at each station. *Five*, an in-plant public address system permits the center to call required personnel to any production station without loss of time. **Telecontrol Division, Hancock Industries, Inc.**, 2137 Book Building, Detroit 26, Mich.

A SMALL air-powered screw driver, called the Cushionair, reduces exhaust noises to a whisper with a scientifically designed muffler which eliminates aggravating sounds without loss of power. Other features of the tool include its compactness and fine balance which make the unit easy to operate; a 5-vane motor; and a built-in lubricator and speed regulator. An easily cleaned air



strainer protects the motor from air line dirt. In addition, the pistol grip models feature a dual-speed throttle: low speed for easy screw starting, and full speed for quick smooth driving once the screw has been started.

A user has a choice of three clutches and two handle styles. The cushion

clutch is for screws that must be driven uniformly to predetermined torque. The positive jaw clutch permits experienced operators to manually control the tightness of the screw. The straight jaw clutch is for applications requiring maximum torque. Both reversible and nonreversible models are available. Each comes with either pistol grip or lever throttle handle (illustrated here).

The Cushionair units, classified as the 000 Series, are available in speeds of non-reversible models ranging from 4500 rpm to 450 rpm. Reversible models have speeds of 3400 to 350 rpm. Maximum capacity of all sizes is No. 12 free-running or No. 8 self-tapping screws. Weights vary, depending on model and handle style, from 1 1/2 to 2 3/4 pounds. Form 5268 describes the screw drivers. **Ingersoll-Rand Company**, 11 Broadway, New York 4, N.Y.

AIR, oxygen, carbon dioxide, argon, helium and hydrogen, at pressures of 1000 to 6000 psig, can be dried in a standardized series of desiccant dryers. Dew points as low as minus 160° F can be achieved, it is said, making the units especially suitable for the fields of industrial testing, research and missilery. The line is called Series A and is described in Bulletin No. D-108 that contains performance data, selection charts and helpful information about high-pressure systems engineering. All sizes are offered in manual, semi- and full-automatic models. **The C. M. Kemp Mfg. Company**, 405 E. Oliver Street, Baltimore 2, Md.

DETAILED performance and application data about a complete line of all-electric, adjustable speed V*S Jr. drives is contained in a 12-page, 2-color booklet, Bulletin D-2507. The publication encompasses typical applications employing the drives from 1/8 through 4 hp, and is well illustrated with photographs and cartoon drawings. Condensed specifications, dimensions and a gear-motor selection table are included. **Reliance Electric Engineering Company**, 24701 Euclid Avenue, Cleveland 17, Ohio.

PRECISE control of flow of any liquid or gas is said to be possible with a device having an elongated, machined, groove-like orifice. An adjustment permits presetting for rates of fractions of a cubic centimeter per minute. The unit performs without the use of springs, diaphragms or other mechanical parts. Its construction reportedly allows it to withstand rough handling, and it may be disassembled, cleaned and reassembled without changing its flow characteristics. Originally developed as a leakage-gauge, the instrument may be

used as a fixed or adjustable flow control, or to calibrate test equipment. Typical is its use for services in which pressure differentials must actuate varying amounts of flow control. Also it is useful in services calling for extremely minute flows, regardless of pressure. *Acme Industrial Company, 200 N. Laflin, Chicago 7, Ill.*

AN IMPROVED device to handle high-pressure gas or liquid is said to be the Quick Hose Connector, currently being used with compressed air to start jet aircraft engines. Formerly this jet starting operation involved many steps; forgetting one of these could be dangerous. With the Besler connector the operator inserts the connector probe into

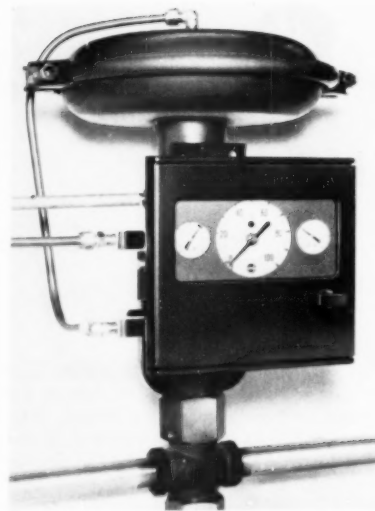


the airplane receptacle. As soon as the engines are started the operator disengages the coupling with a simple tug of the hose. It falls freely to the ground completing the operation. Thus, there is no danger of forgetting to turn off a valve. Under no circumstances will the hose whip or chase the operator. According to the manufacturer, until recently the use of the connector was restricted to certain aircraft, but it now

has been released for use by industry. The unit handles pressures up to 4000 psig; burst pressure is about 20,000 psig minimum. Several designs and sizes are available, providing varying flow capacities. For example, the $\frac{3}{4}$ -inch hose size, at 3000 psig inlet and discharge to atmosphere, will handle 7500 scfm (equal to 650 pounds of standard air per minute). The connector was developed to American Society of Mechanical Engineers and U. S. Air Force standards. *Besler Corporation, 4053 Harlan Street, Emeryville, Oakland 8, Calif.*

A MULTIPLE Readout System is described in a 12-page, 2-color catalog (30B1000). The system measures hundreds of different pressures at a single point in time. Many pneumatic signals are simultaneously converted to digital values, with an accuracy said to be better than one part in 2000, by use of a single transducer. The values are simultaneously stored in a ferrite memory core and then sequentially read out on typewriters, punched tape, magnetic tape, tabulating cards, or fed directly into a computer. The system is built as a data recording unit for values of pressure, temperature, speed, flow, and strain gauge outputs. *Fischer & Porter Company, 225 Jacksonville Road, Hatboro, Pa.*

THE Pilot Positioner combines two functions into one. First, the unit is an indicating pneumatic controller for temperature or pressure; second, it is a valve positioner that amplifies air power to provide accurate and rapid positioning of pneumatically operated control valves. The uniqueness of the device is said to be its combining the two operations into one compact package. By being located close to the process and the valve it controls, the instrument minimizes transmission lags and reportedly provides precision and speed in valve positioning. It can be mounted by a valve manufacturer on most makes



of diaphragm-motor valves, or certain other types of pneumatic operators, and only one air supply. The standard instrument can use any air-supply pressure from 20 to 65 psig. Pressure elements cover the range of 30 inches of mercury vacuum to 10,000-psig pressure. Filled-system thermometer elements cover the range of minus 350° to plus 1000° F. The unit's control set-point knob can be located within the instrument case or on the case door; another option permits remote pneumatic set-point adjustment. A red-tipped pointer indicates set point on center of a 3 $\frac{1}{2}$ -inch dial, on which a black pointer indicates measured variable. To accommodate most valve sizes, a rear mounting plate has three pairs of holes for vertical positioning of the instrument. It is expected that the primary application of the device will be in the process and power industries. *United States Gauge, Division of American Machine & Metals, Inc., Sellersville, Pa.*

TRANSSPARENT, fungus-resistant vinyl insulation sleeving, Resinite EP-

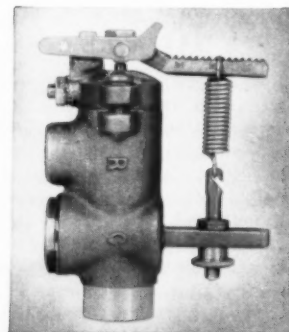
**IT PAYS
3 WAYS**

Saves... **TIME
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24-hour service . . .
all makes and sizes . . .
new valve guarantee.

HOW'S YOUR STOCK OF SPARE VALVES?

CONRADER'S REBUILT UNLOADER VALVE REPLACEMENT SERVICE



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690, allows easy determination of colors and markings of wiring carried within the sleeving. The material is designed primarily for the aircraft and automotive industries. The sleeving has low-temperature flexibility to minus 75° F, high-temperature stability to 185° F and a dielectric strength to 900 v per mil of wall thickness. The material also is self-extinguishing in 6 seconds, and meets Navy Specification MIL-I-631C, grades a and b, for electrical insulation applications. *Borden Chemical Company*, Resinite Department, North Andover, Mass.

A PISTOL-GRIP sandblasting gun, called the Sandy Jet, handles all sizes of abrasives and has three sizes of job-suited nozzles. No separate or special room is needed with the handy tool; the abrasive can be contained in a small area with a simple cardboard box or



cloth. Included with each unit is an operator's hood, a face shield and two extra nozzles. Advantages of the gun are said to be its low cost, portability, lightweight, accurate control, and the ability to clean hard-to-reach locations. *ALC Company*, RD #5, Box 40, Medina, Ohio.

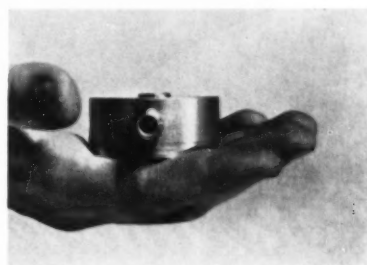
CONCENTRIC in shape, the bands and housings illustrated are contoured to conform to small diameter hose and tubing. They are easily installed in critical applications as small as 3/4-inch



diameter, reportedly assuring perfect circumferential grip. According to the manufacturer, these #5206 and #5306 Hy-Gear hose clamps will reduce to a smaller diameter than any other worm-drive hose clamps now commercially available. With bands and housings made of 18-8 gauge stainless steel, the clamps are available with either a standard-slotted headscrew, or a cadmium-plated thumbscrew. *Ideal Corporation*, 435 Liberty Avenue, Brooklyn 7, N. Y.

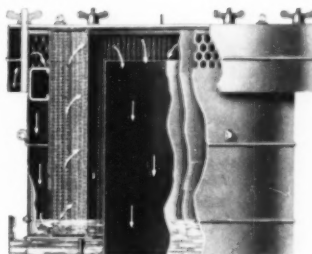
PANCAKE air cylinders, so called because of their wafer-like proportions,

are made for applications where space is limited. The units are said to permit utilization of air power in locations where, in the past, small space precluded



OIL BATH AIR FILTER

for engines, compressors and blowers



The Air-Maze Type F filter provides efficient removal of fine dirt from intake air to reduce wear on engine, compressor or blower parts.

High dirt removal efficiency is attained through its thorough scrubbing action. This scrubbing action

is created by directing dirt-laden air into intimate contact with an oil pool. A "manometer" action created by the air passing a continuous baffle within the pool, causes more oil to be re-cycled than on other types of filter designs. Any dirt that remains in the air is then impinged on metal baffles. The metal baffles are kept clean by constant wash of the oil bath.

Flexible in design, the Type F filter can be furnished with top or bottom outlets, with or without relief valves to handle compressor unloading or line surges. Where noise reduction is a factor, the filter can be furnished with silencing chamber.

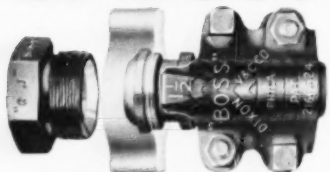
Available in sizes from 20 to 6650 cfm. Write Air-Maze Corporation, Cleveland 28, Ohio. Dept. CA-11. (Subsidiary of ROCKWELL-STANDARD Corporation)

AIR-MAZE

The Filter Engineers

AIR FILTERS • SILENCERS • SPARK ARRESTERS • LIQUID FILTERS
OIL SEPARATORS • GREASE FILTERS

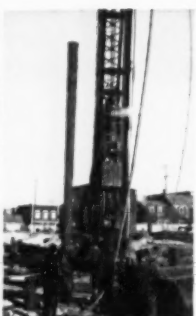
"GJ-BOSS"



GROUND-JOINT FEMALE COUPLING, STYLE X-34

**so Reliable
FOR PILE DRIVING**

**...AND ANY
STEAM, AIR,
WATER AND
HYDRAULIC
SERVICES...
HIGH OR LOW
PRESSURE**



Washerless

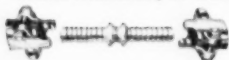
Unequalled for safety, efficiency and long service life. Ground-joint union between stem and spud provides leak-proof, trouble-free seal... no lost or worn-out washers to replace. All parts malleable iron or steel, rustproofed. Furnished with superstrong "Boss" Offset and Interlocking Clamps. Sizes 1/4" to 6", inclusive.

COMPANION MALE COUPLING "BOSS" STYLE MX-16



Companion coupling for "GJ-Boss", described above, and "Boss" Washer Type Couplings Style W-16. Each size fits same size hose... oversize hose not required. Furnished with "Boss" Offset and Interlocking Clamp. Sizes 1/4" to 6", inclusive.

"BOSS" HOSE MENDER, STYLE BM-16



The practical, safe way to restore damaged hose to service. Fitting consists of corrugated mender tube and two "Boss" Interlocking Clamps. Tube has flanges to engage clamp fingers. Thoroughly rustproofed. Sizes 1/2" to 6"

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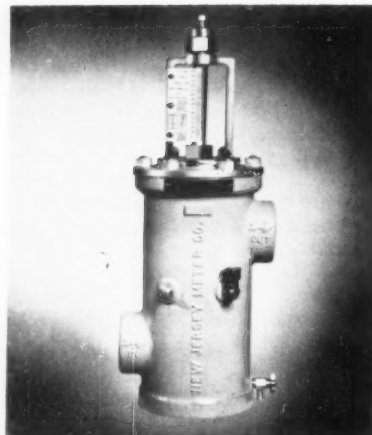
DIXON
Valve & Coupling Co.

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DIXON VALVE & COUPLING CO. LTD., TORONTO Associate Companies
Buck Iron Company, Inc., Garyville, Pa. - Precision Brass Steel Company, Camden, N.J.

its use. Offered in pressure ratios ranging from 1:1 to three times line pressure, the cylinders are available with strokes of 0.010 to 1 inch. Three sizes of the push type are manufactured, and pull and special types, as well as other sizes, can be designed on request. The Pancake Line was developed principally for the tooling industry. *Fabco*, 1231 Main Avenue, Cleveland 13, Ohio.

EFFECTIVE methods for grouting the foundations of compressors, pumps and other heavy industrial machines are explained with text and photographs in Bulletin EPMG-2A. The booklet features the use of nonshrink Embeco Pre-Mixed Grout. Diagrams, charts and pictures show preparatory steps, forming, selection of materials, mixing and placing the grout, with the object of obtaining maximum bearing of machine bedplate on grout. *The Masters Builders Company*, Cleveland, 3, Ohio.

A WIDE-RANGE air meter, the DO-150, permits the measurement of flows from 10 to 150 cfm, in 2-cfm increments. Although it is designed to handle 80-psig air, conversion factors can be used for taking volumetric readings at pressures ranging from 2 to 300 psig. Built



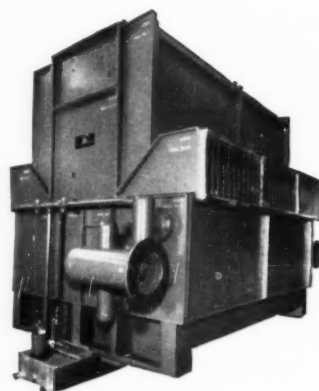
for operation with 2-inch pipe lines, the unit is 19 inches tall and weighs approximately 31 pounds. It is constructed of gray cast iron and brass. *New Jersey Meter Company, Inc.*, 350 Leland Avenue, Plainfield, N. J.

TWO-ELEMENT and single-element air-operated feed-water control systems are explained in a 4-page pamphlet, Bulletin 531. The text tells the principle of operation of each system and a color diagram accompanies each description. To aid in the selection of the

ECONOMICAL COOLING OF GASES AND COMPRESSED AIR

Cooling gases or cooling and removing moisture from compressed air, the Niagara Aero After Cooler offers the most economical and trustworthy method. Cooling by evaporation in a closed system, it brings the gas or compressed air to a point below the ambient temperature, effectively preventing further condensation of moisture in the air lines. It is a self-contained system, independent of any large cooling water supply, solving the problems of water supply and disposal.

Cooling-water savings and power-cost savings in operation return your



equipment costs in less than two years. New sectional design reduces the first cost, saves you much money in freight, installation labor and upkeep. Niagara Aero After Cooler systems have proven most successful in large plant power and process installations and in air and gas liquefaction applications.

Write for Descriptive Bulletin 130.

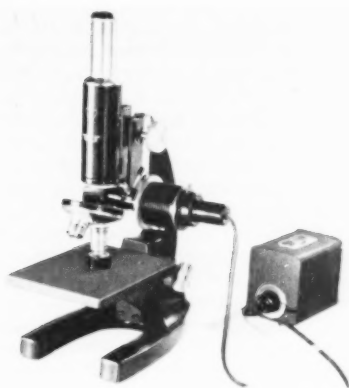
NIAGARA BLOWER COMPANY

Dept. CA-11, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

proper system for each application, a simplified chart is included. *Bailey Meter Company, 1050 Ivanhoe Road, Cleveland 10, Ohio.*

METALLURGICAL microscopes for routine applications in industry and in schools have been designed to provide quick and accurate examinations of opaque objects with the same quality results of instruments much more expensive. The new instruments are said to be easy to operate. They have full-sized control knobs that are readily grasped for all adjustments. All objectives are parfocal and centered in a revolving nosepiece that adjusts automatically for wear. Portable for on-the-



spot examinations and built to high-precision standards, the scopes have coated optics for maximum light transmission and 1-micron divisions of fine adjustment for accurate focusing. Monocular or binocular bodies can be used interchangeably. A wide range of measuring accessories is made. The microscope is available in two models: Model AM-1 with one 8x and, one 40x achromatic objective and one 12.5x Huygenian eyepiece; and Model AM-2 with one 8x, one 20x and one 40x achromatic objective; one 7.5x and one 12.5x Huygenian



"I have to work all night. The Doctor ordered me to take tomorrow off."

NOVEMBER 1959

VICTAULIC®



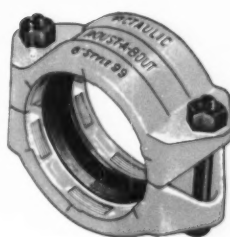
METHOD OF PIPING

VICTAULIC HAS EVERYTHING...



VICTAULIC COUPLINGS

Simple, fast, reliable. Styles 77, 77-D, for standard uses with steel or spiral pipe, — Style 75 for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".



ROUST-A-BOUT COUPLINGS

For plain or beveled end pipe Style 99. Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".



VICTAULIC SNAP-JOINTS

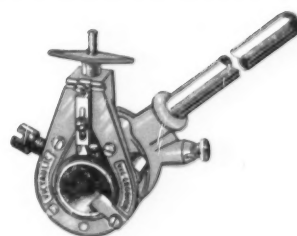
The new, boltless, speed coupling, Style 78. Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB



VICTAULIC FULL-FLOW FITTINGS

Elbows, Tees, Reducers, Laterals, a complete line—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".



VIC-GROOVER TOOLS

Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¾" to 8".

PLUS FITTINGS AND GROOVING TOOLS

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Promptly available from distributor stocks coast to coast.

Write for NEW Victaulic Catalog-Manual No. B-11

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

This NUGENT FILTER will handle pressures to 3000 P.S.I.



Fig. 1555CP-0 Filter

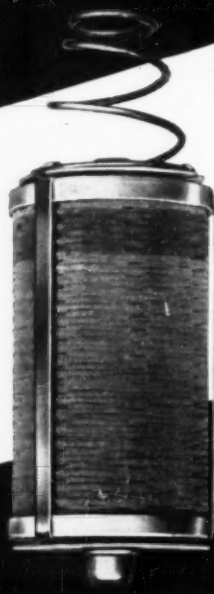


Fig. 1555E-0 Cartridge

Here's big news from the pioneer of fluid filtration. The Nugent Co. introduces the latest addition to their line of fine products . . . a completely new series of Laminated Fiber Disc Filters. Designated as 1555CP, they are designed for hydraulic and other high pressure applications.

Constructed for 3000 psi working pressure, they comply with the requirements of the ASME Code for Unfired Pressure Vessels. API or ASME code inspection and stamping is available.

Five sizes are available with capacities ranging from 1.5 GPM at 3 psi pressure drop to 47.6 GPM at 6 psi pressure drop when filtering 100 SSU viscosity mineral oil. For installations requiring larger capacity, the filters may be connected in multiple. Inlet, outlet and drain are located in the bottom of the filter.

For complete information on 1555CP filters, write today . . . or if your job is *RUSH*, phone ORchard 4-8121, Skokie, Illinois. Our engineers will help you.



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OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

eyepiece. Bausch & Lomb Optical Company, 635 St. Paul Street, Rochester 2, N. Y.

RAPID PICKUP of heavy metal chips, nuts, bolts, sludge, lead grindings, solder spills and punchings is possible with the Vac-U-Max Twin Jet. The unit is said to have been developed as an efficient, low-cost method for pickup of heavy objects and transfer of bulk materials. Operated entirely by air, without motors or moving parts, it is suitable for hazardous applications. Vac-U-Max, 1 Montgomery Street, Belleville 9, N. J.

Books...

The International Series of Monographs on Nuclear Energy (published by Pergamon Press, 122 E. Fifty-fifth Street, New York 22, N.Y.; 4 & 5 Fitzroy Square, London, W. 1, England; and 24 Rue des Ecoles, Paris V, France) will form a complete and authoritative reference covering the entire field of nuclear energy. There are 120 monographs planned for the series, which is divided into fourteen complementary divisions. A new book from each division will be published every 6 months until the end of 1961 at which time the series is expected to be complete. The divisions are: Economics of Nuclear Power; Nuclear Physics; Biology; Isotopes and Radiation; Health Physics; Medicine; Reactor Engineering; Materials; Chemical Engineering; Reactor Design Physics; Reactor Operational Problems; Chemistry; Reactor Theory; and Plasma Physics and Thermonuclear Research. One volume in Division XIV, Plasma Physics and Thermonuclear Research, is the most recent offering and is entitled *An Introductory To Thermonuclear Research*. The work is composed of a series of lectures given in 1955 by Albert Simon, Oak Ridge National Laboratory. The book, reports the publishers, is written for the technical reader who does not have a background of plasma physics. The general editors of the series are R. A. Charpie, Oak Ridge National Laboratory, Oak Ridge, Tenn., and J. V. Dunworth, Atomic Energy Research Establishment, Harwell, England. They are assisted by internationally famous consultants. Additional information about the series is available from the publisher at any of the addresses given.

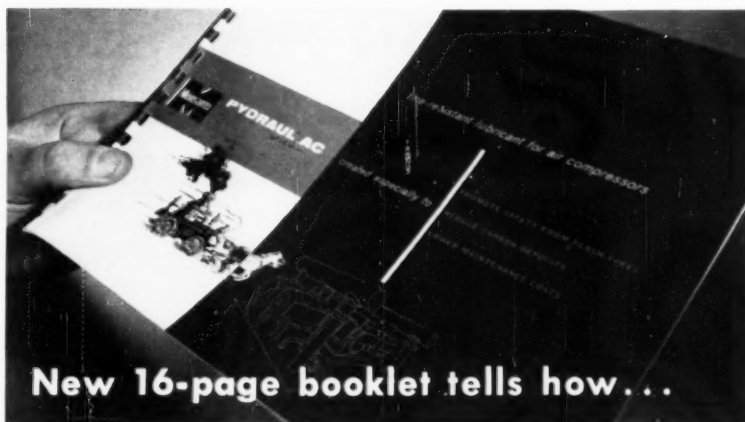
Journal of Research of the National Standards is now published in four separate sections. These include: A. *Physics and Chemistry* (issued six times annually for a subscription of \$4. 75 cents additional for foreign mailing) to cover a broad range of physical and

chemical research, with major emphasis on standards of physical measurement, fundamental constants and properties of matter; B. *Mathematics and Mathematical Physics* (issued quarterly for an annual subscription of \$2.25, 50 cents additional for foreign mailing) to present studies and compilations designed for the mathematician and theoretical physicist; C. *Engineering and Instrumentation* (issued quarterly for an annual subscription of \$2.25, 50 cents additional for foreign mailing) to report results of interest chiefly to the engineer and applied scientist; and D. *Radio Propagation* (issued six times a year for a subscription of \$4, 75 cents additional for foreign mailing) to include research in radio propagation, communications and upper atmosphere physics. Each of the four sections will have either an abstract or a listing of the papers presented in the other three.

Division of the *Journal* into separate sections allows an engineer, scientist or mathematician to subscribe only to those sections within his field of interest. With the division, the publication's scope is also being broadened. In addition to reporting on National Bureau of Standards research, the "new" *Journal* will present review articles by recognized authorities and compilations of information on subjects closely related to the Bureau's research. Further, much of the material which the Bureau has been publishing in nonperiodical form now will be directed to the *Journal*. Copies are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C.

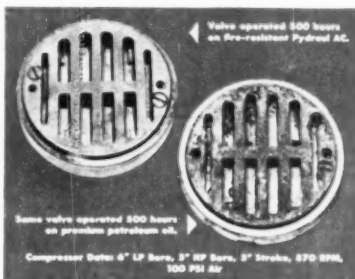
Film...

Asbestos... A Matter of Time is a 16-mm, sound-and-color film that describes the geological formation, modern production and varied uses for the unusual mineral fiber. Opening scenes in the 20-minute motion picture explain how eons ago molten rock flowed, smoldered under tremendous heat and pressure, and hardened; then how it became heavily fissured, underwent other geologic changes and eventually crystallized into asbestos-bearing ore. Next depicted are the modern surface-mining operations—drilling, blasting and removal of the ore from the earth—as photographed at a large open-pit mine in Canada. Finally, the picture describes the versatility of asbestos in its many roles as a heat-resistant fabric, an insulator, a roofing and flooring material, and a packing and gasket medium. The film, sponsored by the Johns-Manville Sales Corporation, may be borrowed without charge from Graphic Services, Bureau of Mines, U. S. Department of the Interior, 4800 Forbes Avenue, Pittsburgh 13, Pa.



New 16-page booklet tells how...

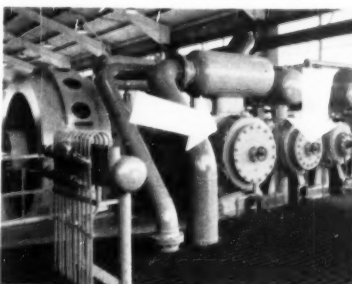
PYDRAUL AIR COMPRESSOR LUBRICANT GIVES 3 "MOST WANTED" BENEFITS AT LOWEST COST: LOW UPKEEP, PEAK LUBRICATION, FIRESAFETY



PYDRAUL AC RUNS CLEAN—can substantially cut compressor upkeep costs because it reduces build-up of carbon and other deposits—extends time between overhauls. Side-by-side photos (above) of an exhaust valve—used in the same industrial air compressor with only the lubricant changed—show how Pydraul keeps systems free from harmful and dangerous deposits than a premium oil. Lower maintenance costs alone usually justify use of Pydraul.



PYDRAUL AC LUBRICATES like premium-grade oil—good anti-wear and noncorrosive features give equipment long life. And Pydraul is the one lubricant for virtually every compressor you own—has demonstrated excellent lubricating efficiency in hundreds of compressors of all sizes produced by all major manufacturers—gives trouble-free compressor operation for many years. Now, Pydraul is effectively lubricating compressors operating at over 4500 psi.—many operating continually with exhaust air temperatures of 340°F.



FIRESAFE PYDRAUL AC GIVES protection 2 ways in this danger zone—guards these three 4,000-hp. compressors. Petroleum oil residues deposit inside cylinders, valves, piping—glow hot and flake off—can unpredictably ignite flammable vapors from hot petroleum-based lubricants, causing fire... explosion! Monsanto's synthetic lubricant, Pydraul AC, essentially eliminates this basic cause of most compressor fires and explosions: It lessens carbon deposits and oxidation residues, and it is fire-resistant.

PHOTO COURTESY GRACE CHEMICAL CO. PYDRAUL—MONSANTO T. M. DIV. OF W. H. GRACE & CO. REG. U. S. PAT. OFF.

New, illustrated booklet gives more details, including how to make the easy conversion to Pydraul AC. Write, today. No salesman will call unless you so request.



FOR CONVENIENCE, USE QUICK REPLY COUPON

Monsanto Chemical Company
Organic Chemicals Division
Dept. CA-4, St. Louis 66, Mo.

Please send me the new 16-page booklet on fire-resistant Pydraul AC lubricant for air compressors.

Name _____

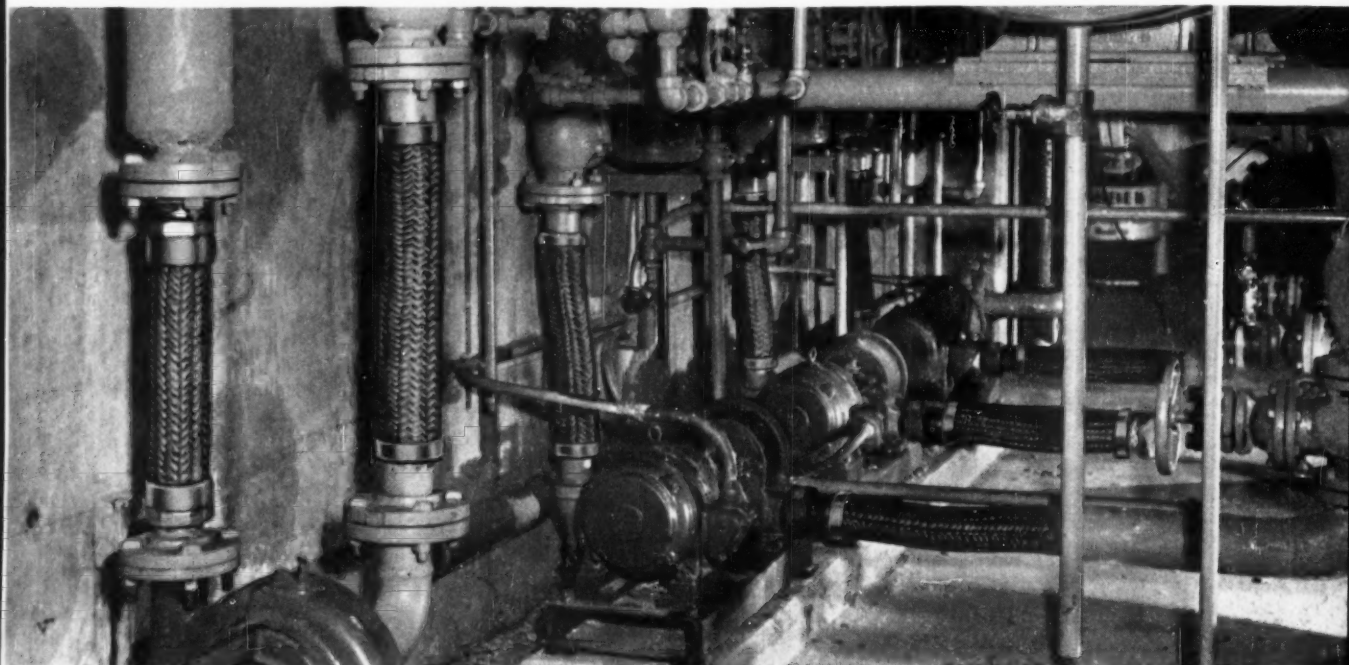
Company _____

Address _____

City _____

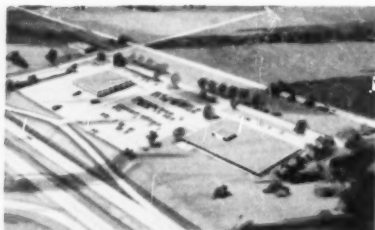
APPLICATION HINTS:

Ways to simplify construction and cut costs with *Flexpipe*



Six Flexpipe connectors, 2½" I.D., 24" long, at the three boiler feed pumps. In the foreground are the Flexpipe connectors at the hot water pump feeding Weathermaster units throughout the Administration Building of the Illinois State Toll Highway Commission.

Flexpipes made this heating and cooling system more compact, cut installation time



Artist's rendering of the Administration Building, Illinois Toll Highway Commission. Lankton, Ziegele, Terry & Associates; Architects and Construction Engineers.

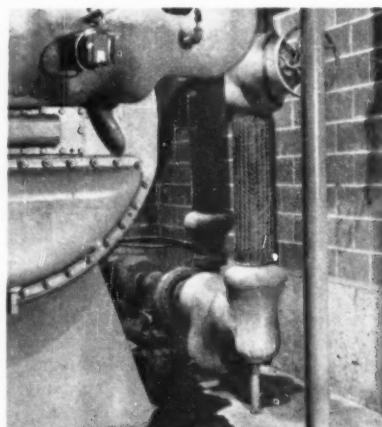
Heating and cooling systems can utilize all the advantages offered by Flexpipe connectors. Flexpipes take up movement caused by expansion and contraction in piping from wide variations in temperature. At the same time, they absorb vibration and dampen noise from pumps.

They make possible better utilization of space because they are easier to install in tight quarters and can

handle offset. Note in photo above how vertical Flexpipes from boiler feed pumps saved space by making possible easy connections to piping flush against wall. Conventional piping would require considerably more work room—plus the time and cost of installing elbows, couplings, short runs of pipe, etc.

Flexpipe's flexible core can be either bronze, galvanized steel or stainless steel—I.D.'s range from ¼" through 16".

WHERE TO BUY: Leading wholesaler distributors can provide you with information about Flexpipe in standard sizes. For the name and address of the distributor serving your area, or for more detailed information, write to: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.



Two 8" I.D. Flexpipe connectors handle cooling water for refrigeration unit.

Flexpipe®
an
ANACONDA®
product

As easy as plugging in your electric shaver...



Wherever you
use compressed
air...

...just

PLUG IN THE POWER

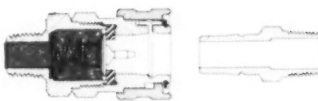
- Handles more air—with minimum pressure drop.
- Quick connection—and disconnection.
- Instant automatic flow or shut-off.
- Handles any job in your shop using $\frac{3}{4}$ " to $\frac{1}{8}$ " connections—from the air line to the air tool.
- Locking ring provides positive lock ...tight fit. Equipped with automatic sleeve lock.
- All Series 2-RL Socket and Plugs are interchangeable—likewise all Series 3-RL Sockets and Plugs. Eliminates any need for various size couplings in hook-up—makes it easy to keep stock of parts in balance—holds inventories to a minimum.

with the
HANSEN
Series RL
QUICK-CONNECTIVE
Ring-Lock
Coupling



Write for
Hansen Catalog...

a ready reference when you want
information on couplings in a hurry.



Socket, when disconnected, automatically shuts off air by leak-proof seal of metal valve against rubber valve seat.

Quick-Connective Fluid Line Couplings for

AIR • OIL • GREASE •
HYDRAULIC FLUIDS • WATER
VACUUM • STEAM • OXYGEN
• ACETYLENE • REFRIGERANTS
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Representatives in Principal Cities

QUICK-CONNECTIVE FLUID LINE COUPLINGS

SINCE 1915

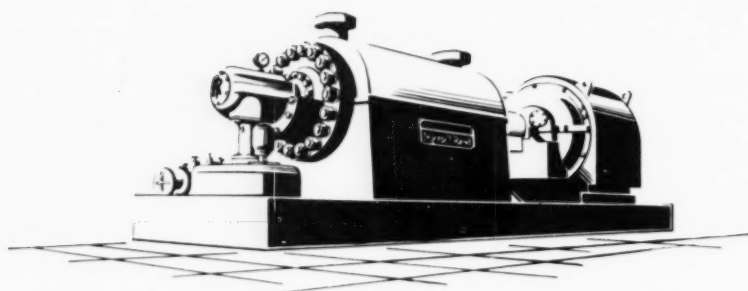
THE HANSEN



MANUFACTURING COMPANY

4031 WEST 150th STREET

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superlatives

that demonstrate confidence in a
high-pressure boiler-feed pump and its builder

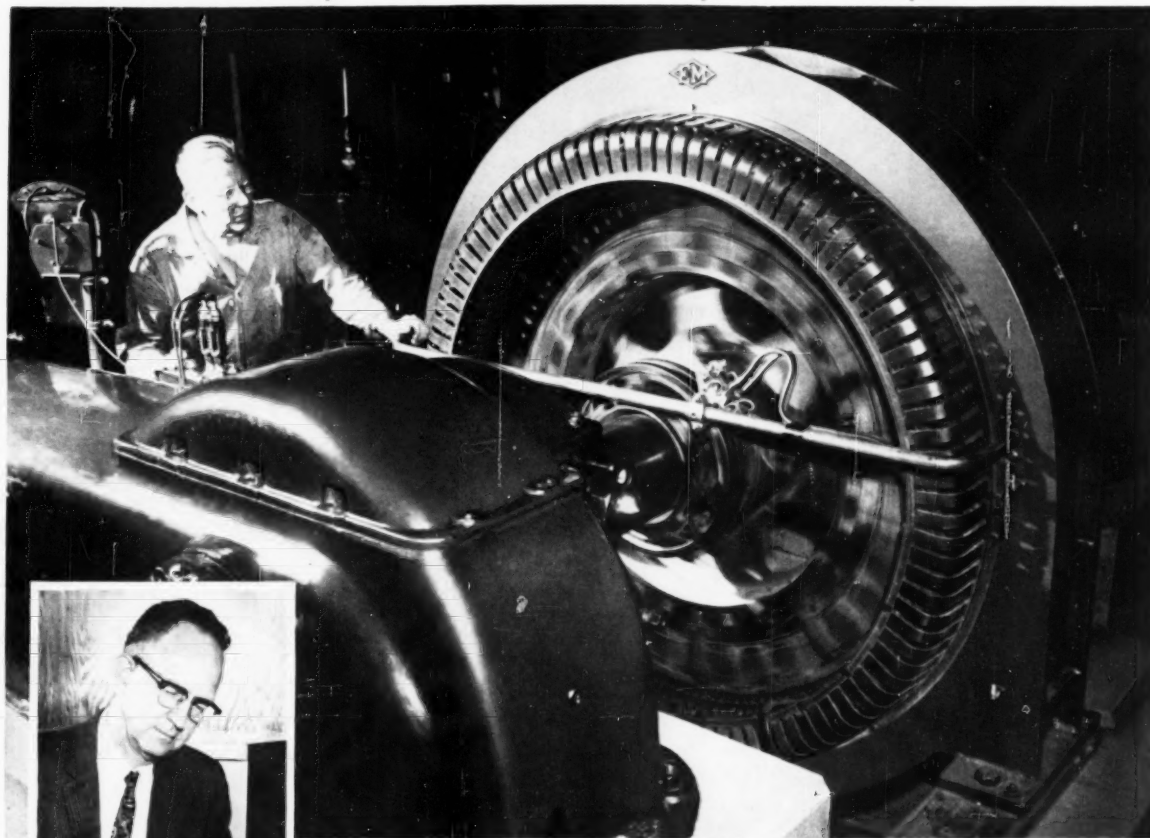
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| LARGEST CAPACITY..... | 7200 gpm. Two record-breaking 7200-gpm pumps with discharge pressure of 4550 psig, for two 450,000-kw generating units. |
| HIGHEST PRESSURE..... | 6500 psig. Two half-capacity units, each consisting of three pumps in series, with discharge pressure of 6500 psig, for a 325,000-kw station. |
| HIGHEST HORSEPOWER..... | 23,000 hp. Two large capacity, high-head pumps, each driven by a 23,000-hp steam turbine, largest ever built for boiler-feed service. |
| LARGEST GENERATING UNIT..... | 500,000 kw. Two turbine driven half-capacity pumps, each handling 4000 gpm at 3108 psig discharge, at 6600 rpm for world's first half-million kw generating unit. |
| GREATEST ACCEPTANCE..... | Ingersoll-Rand has built far more high-pressure boiler-feed pumps than any other manufacturer — including many high-speed units for generating stations. These superlatives demonstrate industry's confidence in I-R Class CHTA pumps, and in Ingersoll-Rand's ability to design and build to any requirements — even those that go beyond previous industry experience. For maximum dependability and long-range economy, specify boiler-feed pumps by Ingersoll-Rand. |



Ingersoll-Rand
10-975 11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

E-M Motor starts equivalent of second 50 years of compressor service!



After running approximately 108,000 hours, this E-M Synchronous Motor is still on compressor duty at Diamond Tool and Horseshoe Co. Contributing to the remarkably long life of the motor was the careful attention of Mr. J. Gordon Mitchell (above), Diamond Tool's electrical maintenance man. The motor is rated 350 hp, 200 rpm, 1.0 PF, 440 volts.

◀ Mr. Hampton Connell, Vice President, Engineering, of Diamond Tool and Horseshoe Co. His company recently celebrated its 50th Anniversary as a manufacturer of hand tools and drop forgings.

"We just can't seem to wear them out!"

Diamond Tool and Horseshoe Co. of Duluth, Minnesota has an E-M Motor on compressor drive that has been running for the equivalent of *40 hours a week for over 50 years—approximately 108,000 hours!* Yet this same motor is still in service 16 hours a day.

Mr. Hampton Connell of Diamond Tool tells this unsolicited story about his untiring E-M Motor:

"This particular motor was installed about 1942, and was in service 24 hours a day, 7 days a week during the last war. Following the war we operated this unit 24 hours a day, 5 days a week for a considerable period of time. For the past several years we have been running the machine 16 hours a day, 5 days a week.

"We have been using E-M Motors in our factory

on our air compressors for a good many years now, and with very satisfactory results."

E-M Motors have earned a reputation for reliability and endurance in many industries. Get more information about them. Call your nearby E-M Sales Engineer and write the factory for free Compressor Number of E-M Synchronizer.

ELECTRIC MACHINERY MFG. COMPANY

MINNEAPOLIS 13, MINNESOTA



1200 TPA 2214

Specialists in making motors do EXACTLY WHAT YOU WANT THEM TO

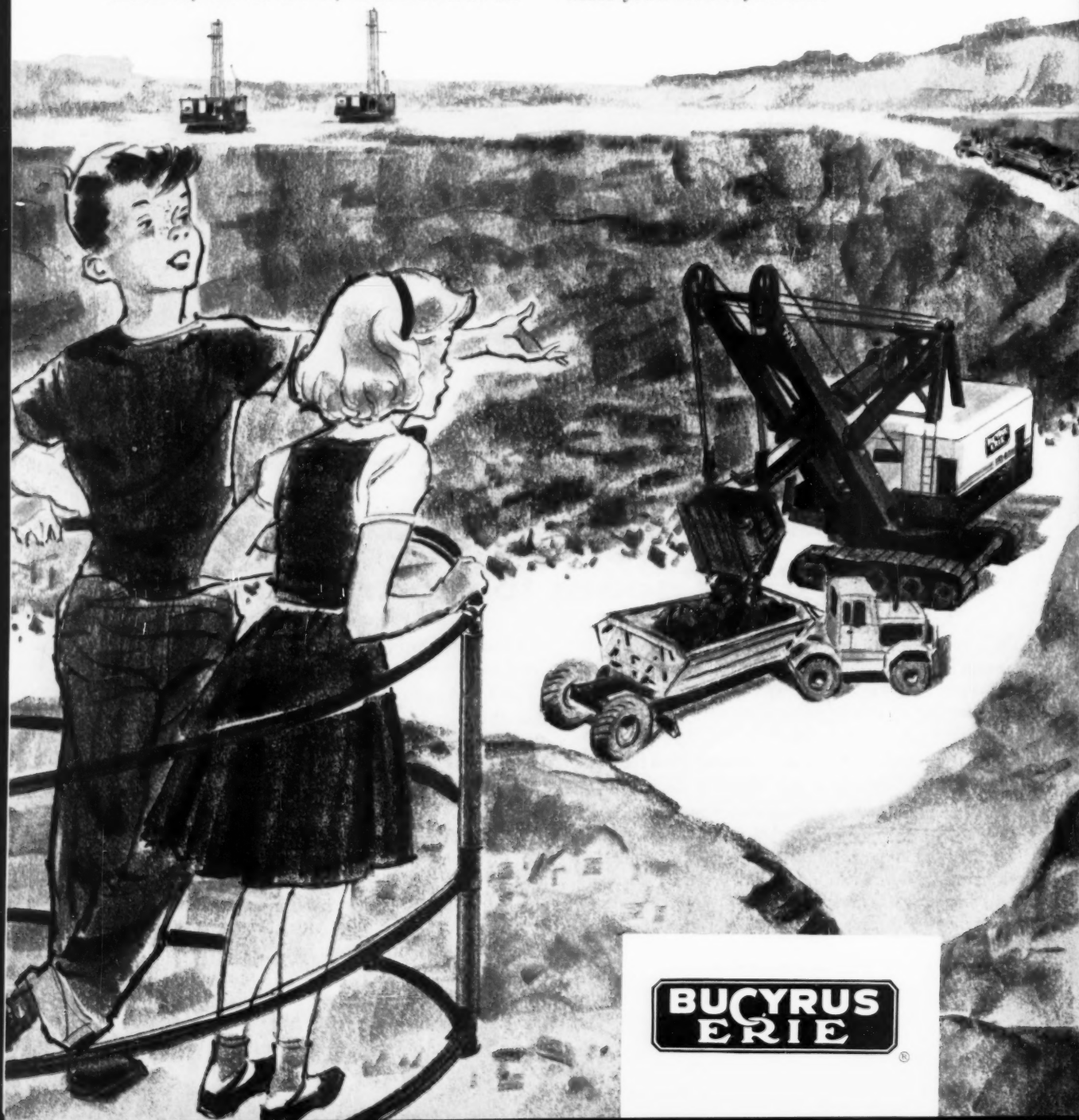
"when I grow up
I'm going to run one of those"

When a fellow daydreams out loud to his best girl, he dreams *big*. Running a big Bucyrus-Erie electric shovel means he's really arrived!

Many a mine or quarry owner who's now "arrived" got his start years ago with Bucyrus-Erie electrics.

That's why two out of every three shovels on the

great iron ranges of northern Minnesota and upper Michigan are Bucyrus-Eries. It's also why B-E machines have long been *the standard* in large quarries, in open pit mines, and on the biggest dam and construction projects all over the world. *Wherever important jobs require the best equipment* — that's where you'll see Bucyrus-Erie.



**BUCYRUS
ERIE**

FOR PRESSURES UP TO 750 psig

NEW Stainless Steel *Fulflo* FILTER



This rugged, compact filter is ideal for high pressure pneumatic and hydraulic applications. Maximum air flow rate is 650 SCFM at 750 psig with initial pressure loss of 3 psi. Flow rate for liquids of aqueous viscosity is up to 5 gpm, depending on nature of fluid, contaminant and operating conditions.

Patented 10-inch Honeycomb Filter Tubes provide true *depth* filtration through hundreds of filtering tunnels engineered for uniformity of size, shape and depth. Tubes are precision manufactured in a wide range of positively controlled densities to provide the exact degree of micro-clarity your operation requires — even down to 1 micron. Tubes are available in cotton, nylon, orlon, dynel, acetate and glass fibres.

Rugged one-piece shell is made from Type 316L stainless steel. All parts are of #316 stainless steel to minimize chemical reaction. Straight line pipe connections are $\frac{3}{4}$ " NPT. Overall filter size is only $13\frac{5}{16}$ " x $4\frac{3}{8}$ ".

Write for Bulletin S600 to Dep't. C.A.

COMMERCIAL FILTERS CORPORATION

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST



with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.



Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.

all types of industries use

BAND-IT. CLAMPS

all
over
the
world

Clamps of all diameters
formed from continuous roll
of stainless steel band
without waste... for a few cents
and in a few seconds.



in approximately 1 cubic foot of space.

Carry BAND-IT tool, band and buckles (all that is needed to form Band-It clamps) in this portable Clamp Warehouse, just like a tool kit. Makes 900 stainless steel clamps of all diameters—for any type clamping job, any shape of object. Especially useful for emergencies such as leaking pipe or hose. 1001 other uses.

SEND FOR NEW, FREE
16 PAGE CATALOG

Over 1500 Authorized Distributors in all principal cities of the United States and in 59 other countries.

BAND-IT CO.

Incorporated 1937

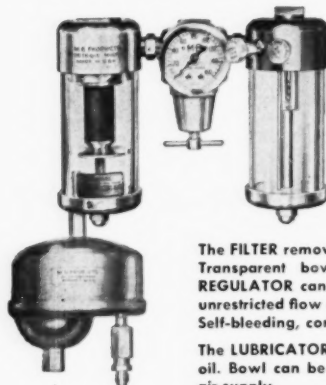
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GREATER PROTECTION to your AIR LINE! **M-B**

WHIRL-A-WAY FILTER, REGULATOR
AND LUBRICATOR ASSEMBLY AND
AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY
USED FOR
PROTECTION
OF AIR VALVES
CYLINDERS
CONTROLS
PNEUMATIC
TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M-B PRODUCTS
46 VICTOR AVE., Div. 14
DETROIT 3, MICHIGAN

protect your equipment

with **DRI AIR**

A complete, self contained unit that collects and automatically ejects water and oil from air lines.

Dri Air collects dirt
and rust thereby re-
ducing wear and
prolonging tool life.



Since 1915 Specialists in Compressed Air Devices

**NEW JERSEY
METER CO., INC.**

350 Leland Ave., Telephone PLainfield 6-8010
PLAINFIELD, NEW JERSEY



Bethlehem Hollow Drill Steel Speeds Rock Removal at Niagara Power Project

This battery of wagon drills is boring blast holes for the Balf-Savin-Winkelman section of a 4-mile trench at the Niagara Power Project. When completed, the trench will accommodate twin 46 ft x 66 ft underground conduits, which will carry water from the Niagara River to a 1,950,000-kw power plant now taking shape several miles below Niagara Falls. On this and other major projects, Bethlehem Hollow provides dependable, low-cost drilling under the most rugged conditions. This "old reliable" steel is available in both Carbon and Ultra-Alloy grades.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL





The Schlitz "headquarters" brewery at Milwaukee uses 4 pulverized coal-fired C-E boilers, Type VU, each with a capacity of 60,000 lb. per hr.



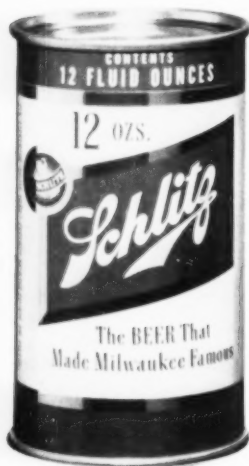
Two oil-fired C-E boilers, Type VU-10, supply 60,000 lb. of steam per hr. for process purposes at the Schlitz brewery in Brooklyn, N. Y.



This 20-million dollar showplace is the Schlitz brewery in Los Angeles, California, which uses 3 C-E boilers, Type VU-10. Fired with natural gas and oil, they generate 90,000 lb. of steam per hr.



At its Tampa, Florida, brewery, Schlitz uses 2 semi-outdoor C-E Package boilers, Type VP. They provide 72,000 lb. of steam per hr.



"The Beer That Made Milwaukee Famous"...

is brewed with **C-E STEAM**

Eleven C-E boiler units, ranging from the semi-outdoor, oil-fired package type to the pulverized coal-fired, vertical unit type, provide the steam to make "The Beer That Made Milwaukee Famous."

Since 1946, when the Jos. Schlitz Brewing Company purchased four C-E boilers as part of an expansion and modernization program at Milwaukee, the Company has purchased C-E units for its breweries in Brooklyn, N. Y., Los Angeles, Calif., and Tampa, Fla.

Due to the nature of brewing and bottling operations, load swings are

wide and rapid, and boiler response must be both unfailing and prompt. How well C-E boilers have met this challenge is evidenced by the repeat order record—a record made even more impressive by the fact that the Jos. Schlitz Brewing Company has obtained consistently high performance with not just one type of C-E boiler—but with three.

When you need a reliable and efficient source of steam—remember that the Schlitz slogan "Move Up to Quality" applies to boilers as well as beer.

COMBUSTION ENGINEERING

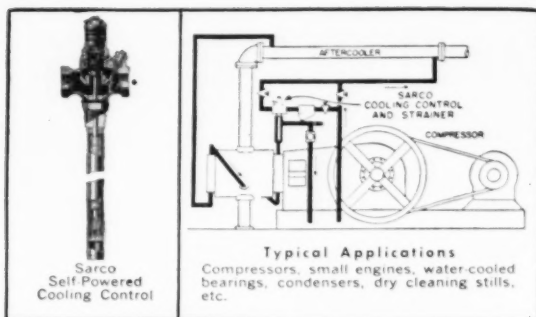
Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.



C-196B

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



Inexpensive COOLING CONTROL

Simple, compact automatic thermostatic valve. Eliminates overcooling and undercooling. Saves water . . . and replaces guess-work with certainty.

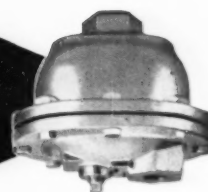
1. Self-powered . . . requires no compressed air or electricity.
2. Self-contained . . . no exposed mechanism.
3. Packless valve . . . single-seated . . . unaffected by silt or scale-forming minerals.

4. Compact . . . 1/2" size only 3 1/4" wide, 15" high.
5. Easy to install by any pipe-fitter.
6. Thousands provide dependable service for firms such as Ingersoll-Rand, Buttle Mfg. Co., Swift & Co.

Write for Bulletin 710 to Sarco Company, Inc., 635 Madison Ave., New York, N.Y.

SARCO

THE "NO-TROUBLE" AIR TRAP



THE ARMSTRONG NO. 21 BALL FLOAT AIR TRAP— GUARANTEED TO SATISFY OR YOUR MONEY BACK

For draining moisture from air lines, (drip pockets, small separators, small receivers, etc.) you can depend on the Armstrong No. 21 air trap for trouble-free service. It's built to the highest standards—guaranteed to satisfy. Can be used wherever no heavy oil or dirt is present. Check the features:

- No Air Loss—valve is always water-sealed.
- Stainless Steel Parts—float, leverage system and valve seat. Valve is heat-treated chrome steel.
- Small, Compact—Simple design, with a strong, cast semi-steel body.
- Self-Priming—no need to add water to start operation.



Bulletin Describes Complete Line of Armstrong Air Traps

Bulletin No. 2024 shows how to select air traps for any job. Gives dimensions, capacities and prices of all Armstrong air traps. For your copy, call your local Armstrong Representative, or write:

8856 Maple St., Three Rivers, Michigan



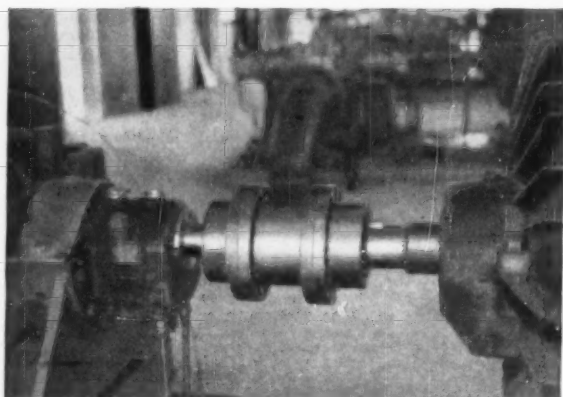
ARMSTRONG MACHINE WORKS

ADVERTISERS INDEX

Air-Maze Corporation	33	Garlock Packing Company, The	2nd Cover
Allen-Bradley Company	3rd Cover	Hansen Manufacturing Company, The	39
Anaconda Company, The	38	Hercules Powder Company	6
Armstrong Machine Works	47	Ingersoll-Rand Company	4, 8, 40, Back Cover
Band-It Company	44	M-B Products	44
Bethlehem Steel Company	45	Monsanto Chemical Company	37
Bucyrus-Erie Company, Inc.	42	Naylor Pipe Company	2
Combustion Engineering	46	New Jersey Meter Co., Inc.	44
Commercial Filters Corporation	43	N.Y. & N.J. Lubricant Co.	48
Conrader Co., Inc. R.	32	Niagara Blower Company	34
Coppus Engineering Corporation	7	Nugent & Co., Inc. Wm. W.	36
Dixon Valve Coupling Company	34	Reliance Electric and Engineering Co.	9
Dollinger Corporation	1	Sarco Co., Inc.	47
Eimco Corporation, The	5	Victaulic Company of America	35
Electric Machinery Mfg. Company	41	Waldron Corporation, John—Subsidiary of Midland Ross Corp.	48
Editorial Index	3		

WALDRON COUPLINGS....

**SAFEGUARD MACHINERY
NEED NO MAINTENANCE**



Waldron standard coupling on crude oil pumps on 20" line from Wyoming to Indiana.

John Waldron makes a complete line of standard couplings. They are all designed to transmit maximum power smoothly and safeguard the connected machines from the effects of misalignment which occur during operation. And, outside of periodic lubrication, the couplings never need maintenance. Hence, once these couplings are installed they will run continuously over the years (often outlasting the equipment they couple) with minimum care and maximum efficiency.

Waldron can stand behind these claims because their standard couplings are made of forged steel and are machined under controlled conditions. The two, one piece cover sleeves and spacer function as a single unit with no flexible metal parts to bend or break. Couplings are oil tight and dust and moisture free.

There are plenty of rough bore standard couplings on the shelves at Waldron and other locations throughout the country ready for immediate delivery. Finished bored couplings may be ordered to customer specifications.



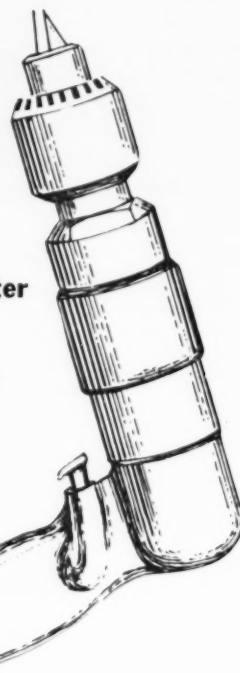
JOHN WALDRON CORPORATION

Subsidiary of Midland-Ross Corporation
NEW BRUNSWICK, NEW JERSEY

WHAT YOU SHOULD KNOW ABOUT AIR TOOL UPKEEP



**Ordinary oil
separates from water**



NON-FLUID OIL
TRADE MARK REG-STERED

emulsifies with water

The NR grades of NON-FLUID OIL work on the principle "if you can't lick moisture, join it." They emulsify permanently with air-borne moisture... go right along with it and protect working surfaces from rust and corrosion, sticking and gumming. Result: your air tools deliver top power and operating efficiency.

That's why pneumatic tool manufacturers use and recommend the NR grades of NON-FLUID OIL for their equipment, and why the NR grades are employed by hundreds of major air tool users. Write for free testing sample and Bulletin No. 550. See for yourself.

NEW YORK & NEW JERSEY LUBRICANT COMPANY

292 Madison Ave., New York 17, N. Y.

WORKS: NEWARK, N. J.

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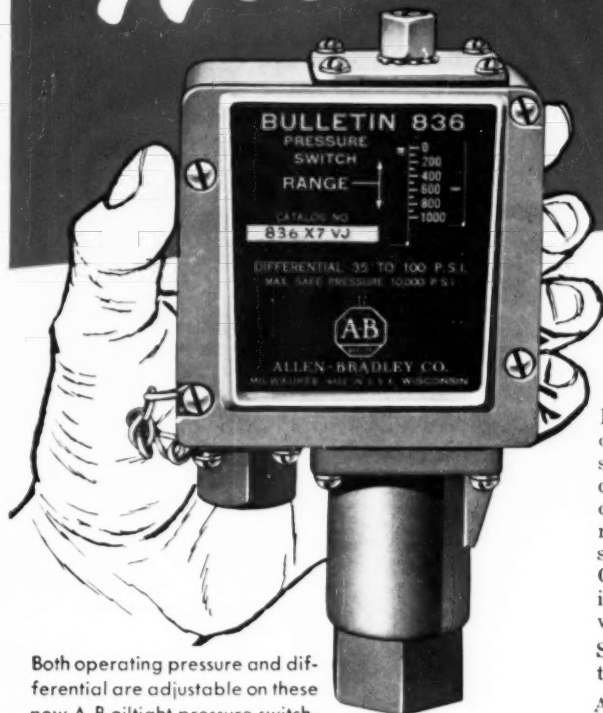
Also represented in principal industrial centers, including Pittsburgh, Pa., Cleveland and Cincinnati, Ohio.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture. So called grease imitations of NON-FLUID OIL often prove dangerous and costly to use.

New

ALLEN-BRADLEY OILTIGHT PRESSURE SWITCHES

Bulletin 836 Type T



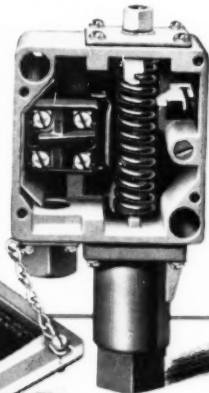
Both operating pressure and differential are adjustable on these new A-B oiltight pressure switches. Operating pressure is externally adjustable, and setting shows on calibrated scale. A trip indicator shows operating point.

For machine tool hydraulic systems—operating at pressures up to 5,000 psi

Especially designed for heavy duty industrial applications, these new Allen-Bradley oiltight high pressure switches assure long, trouble free life. The attractive die-cast aluminum enclosure is completely sealed to exclude oil and water. The snap-action switch mechanism maintains its high contact pressure to the point of switchover—no matter how slowly it is approached. Contact chatter is eliminated—trouble free contact life is increased. The contact block has two isolated circuits with one N.O. and one N.C. set of contacts.

Send for complete information on this newest addition to Allen-Bradley's wide line of *quality* pilot controls.

Allen-Bradley Co., 212 W. Greenfield Ave., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



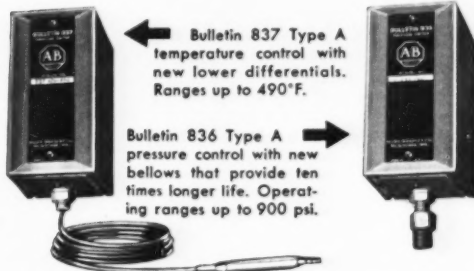
Internal view of piston design used on units for systems above 500 psi. Bellows type construction is used up to 500 psi.

ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Also...A New Line of
Pressure and Temperature
Controls with Lower Differentials



Bulletin 837 Type A
temperature control with
new lower differentials.
Ranges up to 490°F.

Bulletin 836 Type A
pressure control with new
bellows that provide ten
times longer life. Operat-
ing ranges up to 900 psi.

in  heavy-duty

compressors

these **EXTRA-VALUE FEATURES**
mean top performance and economy



**AIR-CUSHIONED
CHANNEL VALVES**
Highest efficiency • Exceptional
durability • Quiet operation



**FULL-FLOATING
ALUMINUM BEARINGS**
Roll with the punch of
each stroke to distribute load

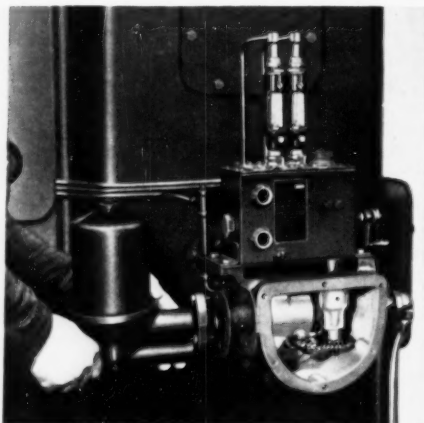


**FULL FORCE-FEED
LUBRICATION**
Filtered oil under pressure
to all bearing surfaces



SEALED FRAME
Keeps dirt out • Keeps oil in
Keeps wear down

◀ *take FULL FORCE-FEED
LUBRICATION for example...*



*a continuous flow of
filtered oil under pressure
to all bearing surfaces
without operator attention*

In Ingersoll-Rand heavy-duty compressors, running parts are continuously lubricated by filtered oil under pressure from a crankshaft-driven pump. All crankshafts and connecting rods have rifle-drilled oil passages, so internal lubrication piping is virtually eliminated. All systems have filters which keep the oil clean and free of impurities. Compressor cylinders receive special oil from separate systems.

This constant flow of oil over all working parts keeps wear to a minimum. In I-R compressors, since the frames are completely sealed, no dirt gets into the oil to cause wear; also, no oil gets out.

Full, filtered force-feed lubrication is only one of the quality features which have earned the Ingersoll-Rand heavy-duty compressor line its reputation for excellence. For more information on compressors of all types and sizes from 1/2 to 7500 hp, for pressures to 35,000 psi and vacuums, call your I-R representative today.



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ESH
20 to 150 hp.



PHE
75 and 100 hp.



XLE
125 to 350 hp.



PRE
400 to 2000 hp.



XPV
(Steam-driven)
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